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MARKET RESEARCH FOR FOOD PRODUCTS AND PROCESSES IN DEVELOPING COUNTRIES

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IDRC-249e

MARKET RESEARCH FOR FOOD PRODUCTS AND PROCESSES IN DEVELOPING COUNTRIES

PROCEEDINGS OF A WORKSHOP
HELD IN SINGAPORE,
1–4 APRIL 1986

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Abstract

Knowledge and experience in the identification and analysis of existing and potential markets for new food products and processes in the developing world is minimal. The main concerns relate to the identification of the needs of low-income communities, particularly in rural areas, and the future direction and strategy of food technology research to satisfy those needs.

From 1 to 4 April 1986, the International Development Research Centre (IDRC) sponsored a workshop in Singapore that brought together food scientists, marketing specialists, and economists. The objectives of the meeting were to create a greater awareness of the opportunities for using market research in guiding food technology projects in developing countries and to highlight market research methodologies that were appropriate for use by Asian scientists. This publication provides case study examples demonstrating market research in food technology projects along with the conclusions and recommendations of the participants on ways to increase the use of this type of analysis in future research.

Résumé

Le monde en développement ne connaît pas beaucoup, ni théoriquement ni pratiquement, les méthodes de détermination et d'analyse des marchés présents et futurs pour les nouveaux produits alimentaires et procédés de fabrication d'aliments. Dans un premier temps il faut définir les besoins des collectivités à faibles revenus, particulièrement les collectivités rurales et préciser l'orientation et la stratégie à donner à la recherche technologique alimentaire pour répondre à ces besoins.

Du 1er au 4 avril 1986 le Centre de recherches pour le développement international (CRDI) a parrainé, à Singapour, un atelier qui a réuni des scientifiques de l'alimentation, des spécialistes du marketing et des économistes. Il s'agissait pour eux de mieux faire connaître les possibilités que présente la recherche sur les marchés comme guide des projets de technologie alimentaire dans les pays en développement et de donner un aperçu des méthodes de recherche sur les marchés que les scientifiques asiatiques pourraient employer avantageusement. Cette publication offre des études de cas d'application de la recherche sur les marchés à des projets de technologie alimentaire, ainsi que les conclusions et les recommandations des participants de l'atelier sur les façons d'augmenter l'utilisation de ce type d'analyse dans de futurs travaux de recherche.

Resumen

El conocimiento y la experiencia de los países en desarrollo en relación con la identificación y el análisis de los mercados tanto existentes como potenciales para los nuevos productos alimentarios son mínimos. Los intereses principales se centran en la identificación de las necesidades de las comunidades de bajos ingresos, particularmente en las áreas rurales, y en la futura dirección y estrategia de la investigación en tecnología para satisfacer tales necesidades.

Del 1 al 4 de abril de 1986, el Centro internacional de investigaciones para el desarrollo (CIID) auspició un seminario en Singapur donde se reunieron científicos en alimentos, especialistas en mercadeo y economistas. La reunión tuvo como objetivos crear una mayor conciencia de las oportunidades de usar la investigación sobre mercadeo para informar los proyectos de tecnología alimentaria en los países en desarrollo, y subrayar las metodologías de investigación de mercados apropiadas para uso de los científicos asiáticos. Esta publicación ofrece ejemplos de estudios de caso en los que se ilustra la investigación de mercados en los proyectos de tecnología alimentaria, junto con las conclusiones y recomendaciones de los participantes sobre las formas de aumentar el empleo de este tipo de análisis en las futuras investigaciones.

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FOREWORD

This publication, the result of a workshop held in Singapore from 1 to 4 April 1986, reflects the strong interest of the Post-Production Systems (PPS) and Agricultural Economics (AE) programs of the International Development Research Centre (IDRC) in promoting a market approach to food technology research in the development process. It has been produced as a further step in addressing the food market research issue in the developing countries and has been aimed primarily at research managers, scientists, policymakers, and students. With the Centre's larger mandate of supporting the implementation of research results for socioeconomic benefit, this publication describes the strategy of linking the researchers and intended beneficiaries of new technology during the various stages of a research project to increase the utilization of research results and the successful adoption of technology.

The objectives of the meeting were twofold. The first was to create a greater awareness of the opportunities for using market research in guiding food technology projects in developing countries. The second was to highlight market research methodologies that were appropriate for Asian food technologists and economists in defining postharvest research needs and the design and evaluation of technology. All the participants felt that these objectives were indeed met.

The editors of this publication must be commended for their appropriate and timely initiative in coordinating this workshop considering the concern about research focus and the implementation of research results. It is hoped, therefore, that this report will serve as a useful guide to market analysis for technical and social scientists involved in food technology and nutrition research in the developing regions of the world and that it will help researchers fulfill the requirements of the ultimate beneficiaries — the poor and those most in need in the developing countries.

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Nutrition Sciences Division, IDRC

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A special thanks is given to the IDRC Asian Regional Office (ASRO) Director, Dr Jingjai Hanchanlash and his staff, especially Ms Jeannie Char, for their support in the organization and administration of the workshop. Appreciation is also given to all the participants who came to share their knowledge providing a unique opportunity to exchange ideas and experiences.

Executive Summary

Introduction

Knowledge and experience in the identification and analysis of existing and potential markets for new food products and processes in the developing world are minimal. The main concerns relate to the identification of the needs of low-income communities, particularly in rural areas, and the future direction and strategy of food technology research to satisfy those needs.

A formalized approach has been increasingly adopted by agricultural scientists in the developing world who first attempt to understand the constraints to improving farming systems. Research is then undertaken to develop improved systems in light of those constraints. Even this approach, however, has a limited focus on sources of farm inputs and consumer markets for farm production.

In the postharvest sector, research is often confined to the laboratory or pilot plant, with products and processes being developed in the absence of a systematic ex ante market evaluation. Similar deficiencies have been characteristic of several nutrition intervention programs. Many projects in the food technology field are never implemented, and the research investment is wasted. Nutrition programs often fail to reach target groups, supplementary foods prove unacceptable or inappropriate, and program costs may be unnecessarily high.

In postharvest research projects, which the International Development Research Centre (IDRC) is currently developing or supporting at Asian institutions, ex ante market and economic research is becoming an essential component in guiding subsequent technical studies. It is evident, however, that the markets in developing countries differ significantly from conventional markets of the industrialized nations, being characterized by consumers with low purchasing power and limited resources. It may, therefore, be inappropriate to transfer the standard methodologies for market research.

Methodology

- Standard market research techniques have validity for developing-country application but may frequently have to be modified.
- Surveys should be well focused and samples may be relatively small. There are political and cultural limits to randomizing samples in certain human

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situations, e.g., supplementary food evaluation. Knowledge of market needs is as important as quantifying them. For key industries, detailed discussions with knowledgeable individuals may be a rapid and inexpensive method of gaining valuable information. Qualitative analysis has as much relevance as the quantitative in developing-country projects.

- New approaches should be considered, e.g., the use of psychology and anthropology.
- It is essential to continue to monitor the application of market research techniques in developing countries, to learn from the process in particular situations, and to devise useful modifications.

Training

- There is a need for market professionals in the developing countries. Training of food technologists in market research techniques is also needed. The means of developing this expertise requires serious consideration. Developing-country projects are complex. Competent professionals are required to achieve project objectives. Projects will invariably benefit from inputs by qualified consultants during the first stages of project development.
- Appropriate sources of training in Asia should be identified.
- Market research should be an ongoing activity to develop competence through experience. Momentum in market research should be maintained not only for national development agencies but for research institutions as well.

Financing

- National and international agencies should recognize that market research may substantially increase the cost of development projects. Nevertheless, projects will be more cost effective in terms of implementation and delivery of results.
- Costs must be minimized by careful focusing and sampling limitations consistent with maintaining reliability.
- Financing agencies may need to consider adopting policies to permit the involvement of key business management and market consultants in development projects.

The papers and case studies presented here reinforce the objectives of the workshop: to realize the potential of market research and to identify appropriate methodologies for technologists and economists in defining food research priorities. The authors are specialists drawn together from various backgrounds and disciplines including market specialists, food technologists, nutritionists, engineers, and economists. The participants also reflect the interdisciplinary approach required to conduct valid market research in developing-country environments. Different countries and regions are represented as well, with the majority being from Asia along with others from Latin America and New Zealand with input from Africa. Several of the participants are involved in IDRC-supported projects in food technology.

From this core of expertise and experience, a number of conclusions with regard to the status of food market research in the developing countries and recommendations for future research designs have been elaborated and are summarized here. This section is followed by papers covering the analysis and development of market research for food and nutrition projects in developing countries. The last section presents a series of case studies covering IDRC-supported projects in Asia. A more detailed description of the standard procedures and techniques that can be used for market and survey research was prepared for the meeting and is given in *Market Research Methods* (IDRC-MR151e). Their application and modifications for developing-country settings are also highlighted.

Conclusions

The following conclusions and recommendations were developed by the participants at the workshop.

General

- Market research has a major role to play in defining food technology research in developing countries. It is an essential scientific discipline and should be recognized by national institutions and merit given for market analysis activities in development projects. It is an integral part of the research process, not a separate entity.
- Market research has not traditionally been part of the food technology research process in developing countries.
- There is a need to demonstrate successful market research projects through a subsequent publication on case studies. Perhaps case studies that have indicated the reasons why a project will fail should also be publicized.
- Experience in research design and idea generation through group discussion should be strengthened.
- Market research should be combined with microeconomic analysis in the same project.
- There is a need to begin forming a secondary data base by pulling together existing data in developing countries.
- It is essential to set attainable objectives at the outset. There is a tendency to set ambitious objectives in developing-country projects because of pressing social problems.

PART I

PRACTICE OF MARKET RESEARCH IN FOOD DEVELOPMENT PROJECTS

Market Research and Food Technology in Developing Countries

In the developing countries, the use of market analysis to define problems and formulate appropriate solutions in the food technology sector is minimal. Many research projects aimed at improving the postharvest handling of foods or at combating malnutrition are initiated in the complete absence of reliable data on the intended market. Because of the special characteristics of, and the constraints associated with, the social markets in developing countries, the analysis of these markets may require a methodology that differs from that applied in industrialized countries. This paper compares conventional and social market research strategies and outlines the difficulties of undertaking such research in developing-country environments. Some recent experiences, which illustrate the needs and opportunities for a market orientation in food technology research projects in developing countries, are described. It is concluded that market research in the developing regions should be strengthened by creating a greater awareness of its importance at the national level, developing appropriate training courses, and elaborating appropriate research methodologies.

For organized industries in the developed world, market analysis represents the essential basis for product or process development. A project has no economic future unless an adequate demand exists for it. Market research, therefore, aims to identify consumer needs, market segments, and the purchasing process to minimize uncertainty in making marketing decisions. Conventional marketing emphasizes the attainment of profits through the identification of opportunities, and even the creation of needs, in a competitive, consumer-oriented industrial environment. Marketing has, therefore, emerged as a scientific discipline that responds to the needs of industrial companies for market information.

In the developing world, scant attention has been given to the application of market analysis to define and guide agricultural research and development projects, which includes the subsector of food technology. Perhaps this is because considerable demand for staple foods exists in the developing countries and the problem is one of overcoming food deficits and inadequate nutrition in noncompetitive markets rather than creating new markets. The target market is characterized by poor consumers, usually in rural areas, and limited resources. There has, therefore, been a tendency to assume that increases in the production of

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staples will be readily absorbed by a demanding market. Innovative research by agricultural scientists has indeed resulted in the development of high-yielding food plants with superior functional and nutritional properties and adaptable to a wide range of agroclimatic conditions. Nevertheless, it has invariably proved difficult to persuade the poorer farmers to grow the improved varieties and, in many cases, consumer acceptability problems have arisen where improvements have affected food characteristics. In recent years, there has been an increasing realization that the starting point for productive agricultural research should be the farmer's field. It is essential to have a thorough understanding of the technical, social, and economic constraints of traditional farming systems to define research that will lead to changes of benefit to the farmer. This is effectively a form of market analysis but proceeds a stage further in creating a relationship between researchers and farmers in designing and conducting agricultural projects.

Although agricultural scientists in developing countries are progressing in their use of systematic market evaluation for research project design, a comparable approach is less evident in the postharvest sector. Research in this sector normally aims to

(a) Reduce postharvest food losses by improved storage, drying, or other processes;

(b) Improve existing, or establish new, agroindustrial enterprises; or

(c) Design and implement interventions for improving human nutrition.

Here, research is often confined to the laboratory or pilot plant, with products or processes being developed in the absence of ex ante market evaluation. In view of this omission, many projects in the food technology field in developing countries are never implemented, and the research investment is wasted. Perhaps the most eminent example of such wasteful exercises in nutrition is what McLaren (1974) terms the "great protein fiasco." As is now well known, the massive investments in protein technology research made during the two decades before the mid-70s were not justified by reliable data on the needs, habits, and economic status of the intended users. Consequently, the results of these abundant research efforts have remained mainly in textbooks. In her comprehensive review of this topic, Orr (1972) stresses its marketability and that the dietary patterns of the potential consumers must be fully appreciated. Marketing is now increasingly cited as an indispensable tool for the design of food technology and nutrition projects and for facilitating the commercialization of socially desirable food products in developing countries (Sheth and Sudman 1972; Austin 1980; Cavusgil et al. 1983; Hulse 1984; Gopaldas and Rutman 1985).

Given that the social market in developing countries is somewhat distinct from the conventional markets of the industrialized nations, it may not be appropriate to transfer the standard methodologies for market research. The various constraints existing in developing countries will demand the development of a modified framework for market research in problem definition for food technology projects. It is hoped that this workshop will highlight the opportunities for market research in this area, the existing constraints, and the techniques that may be used to obtain reliable market information. To set the scene, this paper will present a brief overview of market research methodology, discuss some limitations in conducting social market research in the developing-country environment, and

describe some recent experiences in the use of market analysis to define food technology projects.

Conventional and Social Market Research Strategies

A market is a system of exchange that develops as people cease to produce entirely for their own consumption (Toffler 1981). Historically, the introduction of new technology has resulted in increased specialization of production; in turn, making people more dependent on an expanding and more complex market to exchange what they produce for articles they have to and wish to consume.

In Asia, particularly Southeast Asia, the national food systems are becoming more market oriented (MacCormac 1985). This is reflected in a change from an agrarian society food system per se (Fig. 1) to a mix of agrarian and industrial society food systems (Fig. 2). Asian food systems still contain elements of both, but are increasingly mirrored by Fig. 2. Thus, the number and types of market

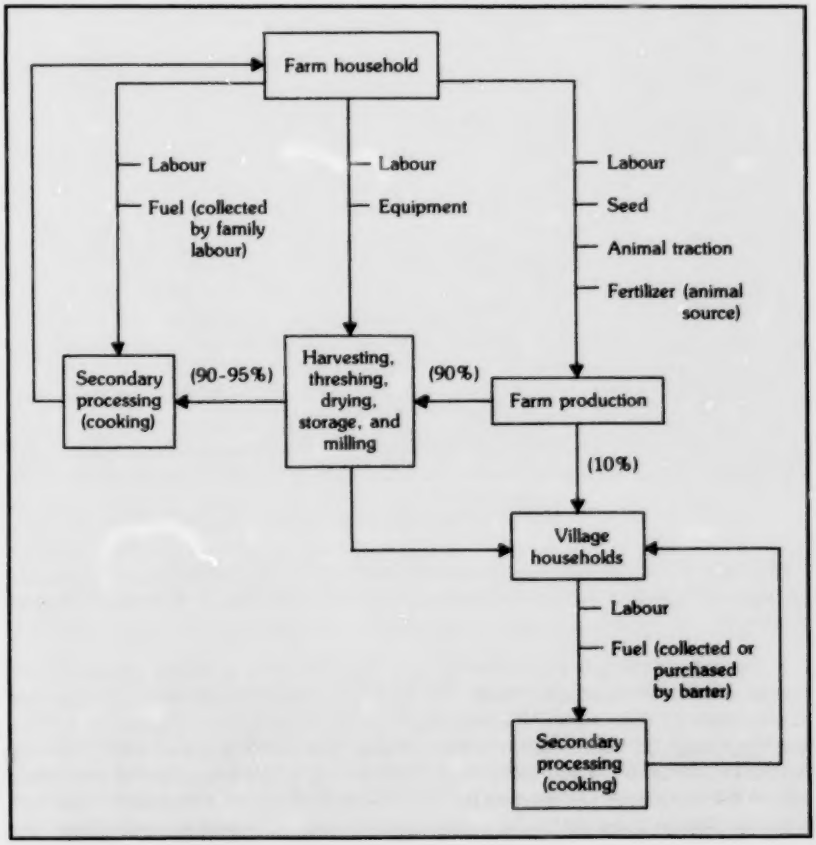

Fig. 1. Agrarian society food system (source: MacCormac 1985).

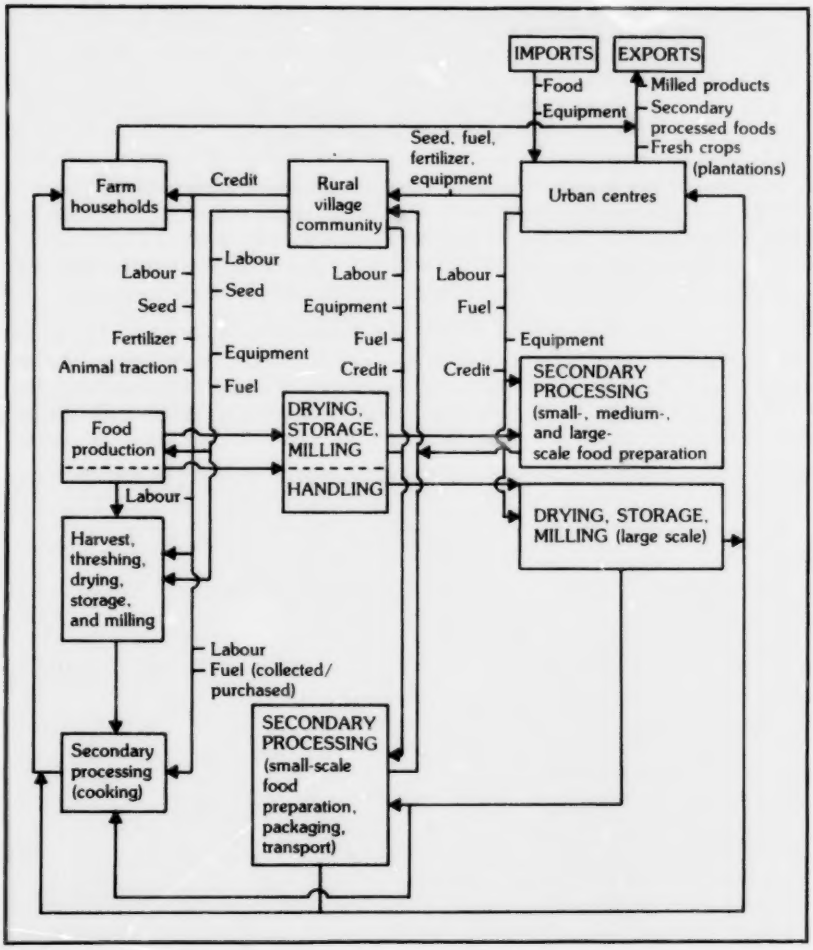

Fig. 2. Agrarian/industrial society food system (source: MacCormac 1985).

exchanges are expanding. Concomitantly, the need for market analysis also increases if the national food system is to achieve both private and social objectives efficiently.

Before we discuss conventional and social market research strategies, we should ask the question: can marketing contribute to real economic development in the developing countries? It is important to ask this question because one of the main purposes of market research is to develop a technology (product or process) marketing strategy (Austin 1981). Although the principal focus of this workshop will be the use of market analysis for problem definition, we must remember that any new technology must be marketed. Marketing generates individual and community expectations for satisfying needs and encourages consumption and investment in related technology (Nielson 1974). The source and pattern of that

consumption and investment has associated income distribution and growth effects and is not independent of the marketing strategy.

Our opinion is that food product and process marketing can have positive net benefits in terms of economic growth and public welfare. To achieve these benefits, however, the market research strategy should develop pricing, promotional, and distribution techniques that reflect real costs, are informative and educational, and minimize monetary income distribution bias in favour of the high-income groups. It should not attempt to create needs.

Food technology research projects may have conventional or social objectives or combinations of both. In conventional marketing, emphasis is given to the attainment of break-even points or profits and may specifically exclude poorer consumers. On the other hand, social marketing accommodates poorer consumers and aims at national goals despite relatively limited sources (Cavusgil et al. 1983).

The marketing and market research strategies associated with conventional and social food technology research objectives are different. Conventional market research starts with identification of consumer needs or aspirations, competition, and market segments (for maximum economic returns). The information obtained is then used to develop a technology, determine market entry prices, and select methods of technology promotion and distribution. This "marketing mix" is evaluated using economic criteria such as, number of sales to break even, profits, and growth in market share.

Social market research identifies human needs in noncompetitive societies and defines the means of delivering technologies to satisfy these needs. Further analysis quantifies specific needs, develops technology, and selects market entry prices, techniques of promotion, and systems of distribution. This "marketing mix" is evaluated using criteria that differ from those employed for assessing marketing strategies. Criteria such as percentage of the target population reached with the technology, quantities of the technology produced and distributed, and frequency of use of the technology may be used. Benefits are measured in terms of development goals, such as improved nutritional status or increased rural income. The use of economic criteria is generally limited to the latter and to selecting the least-cost strategy to achieve a quantitative goal. The use of a social market research strategy, however, should not automatically eliminate the use of conventional criteria because these improve the efficiency of some aspects of the social strategy without reducing the attainment of social goals (Cavusgil et al. 1983). As already stated, a food technology research project may have both conventional and social objectives. Before development resources are committed to the research or implementation of the results, however, we should carefully determine whether objectives are independent, complementary, or competing.

Problems of Social Market Research

For market research to be useful, it must be reliable. Under the conditions existing in the developing countries, reliability may be questionable unless certain factors are taken into account. Normally, field-survey results are supplemented by secondary data collected from government or trade statistics. Secondary data are particularly important for demand forecasting and the prediction of the project profitability. The experiences of Stanton et al. (1981) in Latin America appear to

reflect the general norm in the developing countries. Deficiencies in availability, currency, validity, and homogeneity of secondary data cause difficulties in interpretation. Austin (1981) recommends that analysts verify the accuracy of such data to ensure reliable projections by evaluating the data-collection techniques. It is also appropriate to retain a sceptical attitude toward published statistics because erroneous data tend to be self-perpetuating.

The collection of primary data through field surveys is subject to considerable drawbacks, particularly when rural environments are being studied. As Kaynak (1978) notes, the validity of primary market research depends upon (a) an organized and competent team of interviewers who are well acquainted with the respondent population, (b) a correctly selected representative sample, (c) carefully designed and pretested questionnaires, and (d) adequate financial facilities. These critical issues are discussed in the following.

Personnel

Formalized market research is a relatively recent development, even in industrialized countries. It may, therefore, not be surprising that the activity is poorly supported in the developing nations. Kaynak (1978) states that marketing research and consultancy firms and even independent, experienced interviewers and market research analysts are generally unavailable in these regions. Moreover, in the case of small agroindustries, the financial and managerial resources at hand may be too limited to conduct thorough market research. For this reason, Austin (1981) suggests that this function be carried out through government assistance to the entire industry or sector. Unfortunately, the social project attitude that may permeate government interventions in developing countries tends to become an excuse for the inefficient performance of marketing functions (Cavusgil et al. 1983). In essence, there appears to be a dire need to fuse the social commitment characteristic of governments and voluntary organizations with the motivational and efficiency characteristics of private sector business managers.

Market researchers and analysts from the industrialized nations, who have undertaken studies for companies interested in entering developing-country markets, consistently note the benefits of seeking local inputs in problem or concept definition and in the actual surveys (Goodyear 1981; Kushner 1981; Stanton et al. 1981). Western researchers who have not sought such assistance have experienced radical difficulties because of differences in the use of language, in lifestyles, and in the beliefs and values associated with a culture. Thus, the ideal market researcher in a developing environment will have an intimate knowledge of that environment and a thorough grounding in appropriate survey techniques. In view of the experience in field research that is gradually being built up by many food scientists, nutritionists, and home economists in the developing countries of Asia, it could be argued that an invaluable core of potential market researchers is emerging. Such a body of experience requires further support through appropriate training in survey and analytical techniques. This workshop represents a beginning in the process of information exchange and training. Serious consideration, however, should be given to establishing formal courses in market analysis and business management for food scientists and nutritionists in the developing world.

Sampling

Proper sampling is fundamental for reliable market research. Conventional methodology, however, is difficult to apply in the developing countries because of

limited statistical information (Kaynak 1978; Stanton et al. 1981). Although sampling frames may exist for some metropolitan areas, their period of usefulness may be minimal in the face of rapidly expanding and shifting populations. Given the expense of maintaining these frames, governments tend to forego the activity and official census maps become outdated. Thus, precise sampling is not feasible and market researchers resort to the use of stratified, quota, area, and convenience sampling techniques based on incomplete maps and population data. Calculation of the sample error and determination of valid population inferences then become extremely difficult. From their experience in Latin American countries, Stanton et al. (1981) report that quota sampling procedures can be so divergent and uncontrollable in different countries that the comparability of the data is severely affected. The problem is exacerbated by other complications, such as the existence of multifamily households. In the rural areas of developing countries, interviewers often apply random walk procedures in the selection of samples (Funk 1963). Although these constraints dictate that truly random sampling may not be feasible in the developing countries, it should at least be possible to ensure that the sampling units reflect the social environment selected for the purpose of the study.

Survey Methods

Conventionally, market data are recovered by means of telephone, mail, or direct interview surveys. Because of the characteristics of the social market in developing countries, however, direct surveys and interviews are the most feasible. Personal interview is often the only method of obtaining reliable information. Even then, obstacles may be created by nonresponse in view of social and cultural inaccessibilities. As Kaynak (1978) notes, in Asia women may be culturally and socially inaccessible to interviewers whereas in other areas men are relatively inaccessible. Indeed, sexual differences between interviewer and respondent may become an important source of research bias (Kraemar 1971). Other factors causing bias include the inevitable presence of other individuals (clinical witnesses) during the interview and the tendency for respondents to provide answers that they think the interviewer wishes to hear.

Survey questionnaires need to be designed to eliminate, as far as possible, the effects of these biases. Stanton et al. (1981) define three possible approaches in questionnaire design:

(a) The EMIC approach, which holds that attitudinal or behavioural phenomena are expressed in a unique way in each culture;

(b) The ETIC approach, which involves the creation of a questionnaire that is multinational and culture free in its application; and

(c) The HYBRID approach, which combines country-specific concepts with "pan-cultural" ones not having a specific cultural bias.

In general, the EMIC and HYBRID approaches would appear the most appropriate. Questionnaire design and presentation may vary widely even within the same region or country depending upon the respondent group targetted. Suitable formats are likely to be simpler than those used for conventional market analysis. As previously stressed, the involvement of market researchers having an intimate knowledge and sympathy with the environment and populations under study is crucial. To direct research for the benefit of poorer people, statistical purity

may be less important than broad coverage, the appropriate objective being to understand rather than to measure precisely (Pickard 1982). Thus, exposure of researchers to the realities of specific end-user environments may be the key issue. Goodyear (1981) believes that qualitative market research should be employed in developing countries. Qualitative research establishes certain basic dimensions of unfamiliar, uncharted markets. In qualitative interviews, the questions are not predetermined. Instead, feedback from the respondent determines the development of the interview. Such feedback from the intended beneficiaries of potential research is invaluable in assisting the researcher to understand the user environment, rather than merely measuring certain characteristics of it.

Financing Market Research

Thorough market research can be an expensive and time-consuming venture. As noted earlier, the financial and managerial resources of developing-country institutions are often too limited to undertake this function. National market services for an entire industry or sector could be established at minimum cost. It will also be important to focus market research carefully so that only relevant and usable data are collected. Market research information should be balanced against cost so that researchers obtain adequate amounts of quality data at least cost (Austin 1981). To achieve this, sound judgment is required.

Recent Developing-Country Experiences

Recent experiences in Asia have highlighted the needs and opportunities for market research in defining food technology projects. Appropriate case studies will be presented in this workshop. The following sections briefly discuss the relevance of market research to several postharvest themes of interest to the International Development Research Centre (IDRC).

Rice Postharvest Technology

In Southeast Asia, the development of early maturing, high-yielding varieties (HYVs) of rice resulted in at least one crop being harvested in the wet season. The problem identified was "wet paddy" and the solution proposed was artificial drying (GTZ 1982). Thousands of man hours and millions of dollars went into research and development activities to produce new drying technology. To date, none of the technology developed has been widely accepted, with most of the wet-season paddy being dried by sun and wind. Although the developed equipment is technically capable of drying paddy, the technology proved too expensive and of inappropriate capacity for the intended users. Its introduction was not accompanied by appropriate training in its fabrication, use, and repair (Manilay and Cardino 1984). Moreover, government price regulations provided little or no incentive for improving quality through drying.

Grain Storage

In both South and Southeast Asia, farm households maintain a large (often the largest) proportion of their crop for their own consumption, either as food or seed. Estimates of loss in on-farm storage indicated potential benefits from loss reduction (National Academy of Sciences 1978). Much research has been undertaken to design improved or new on-farm storage structures. These have met with limited success because of high cost (certain types of loss being valued too high by

the scientist) and very often because farmers wish to preferentially protect their seed, rather than the entire stored crop. In this case, the farmer's perception of farm household risk and uncertainty places priority on the ability to plant the subsequent crop. Avoidance of losses of the recently harvested crop becomes a secondary consideration.

Fish Drying

In most developing countries with coastal fishing communities, sun-drying is a traditional method of preserving fish. Scientists had correctly concluded that this often results in nonuniform drying, physical damage, and fouling from insects and animals. Moreover, revenue is lost when drying is not possible because of rain. Research was implemented to improve product quality by developing artificial drying procedures. To our knowledge, results to date show that low-income rural and urban markets in developing countries do not differentiate significantly, through price incentives, between sun-dried and artifically dried fish. This means that the utilization of drying technology is limited to rainy periods only, and the returns are not sufficient to recover the relatively high fixed costs of the dryer.

Fruit and Vegetable Handling and Processing

Horticultural crops provide farm cash income and employment opportunities for rural populations in developing countries. In many cases, the produce may find high-value markets distant from the production points. Nevertheless, because of the perishable nature of these commodities and the lack of adequate handling facilities, losses are extensive. Preliminary market analysis can effectively define important areas for improved handling and processing. Unforeseen opportunities for supplying a market demand and generating rural income may often be identified by well-planned ex ante studies. For example, an IDRC-supported study recently completed in Sri Lanka highlighted potential for partial processing of fruits and vegetables as a viable rural venture (Curtis and Gunetileke 1984). The results of this study will form the basis of a more comprehensive research project to develop and improve the handling and processing of horticultural produce in the country.

Processing of Dryland Crops

Sorghum and millets represent the staple diet of poor people inhabiting the semi-arid tropics of South Asia and Africa. Little attention, however, has been devoted to improving the processing and utilization of these crops. Between 1977 and 1980, a study was conducted in India with the objective of obtaining an understanding of traditional practices for the storage and processing of sorghum and millets in rural areas (Pushpamma and Chittemma Rao 1981). This study produced invaluable information that has led to the design and implementation of improved dehulling and milling technologies for poor rural people.

Nutrition Interventions

Definition of the market and the consumer is essential for nutrition interventions, such as government programs to serve malnourished children (Austin 1980). Nevertheless, a market orientation is often lacking in projects aimed at designing and delivering items such as supplementary foods to target beneficiaries. There are many examples of nutrition programs that have been founded on insufficient market data on food or weaning habits, socioeconomic status, and

lifestyles of the intended beneficiaries. Inadequate appreciation of marketing and delivery systems for supplementary foods invariably leads to "leakage," poor targetting, and high intervention costs. Several authors have demonstrated the valuable contribution to be made by market research to the effectiveness of nutrition programs (Valverde et al. 1981; Gopaldas 1983; Mongkolsmai and Kietdaj 1984).

Future Needs

Clearly, market research is a prerequisite for reducing uncertainties for the adoption of the results of food technology projects. Such studies should be incorporated as a component of a total systems research effort. The Post-Production Systems and Agricultural Economics programs of the IDRC collaborate whenever possible to support short-term interdisciplinary studies to identify specific postproduction needs of national food systems. The results of these studies may then be used by national scientists to develop technology development and improvement programs, geared to end-user requirements. This approach to support for postharvest food research will continue to develop and expand. To strengthen such activities, the following actions are needed:

- To create an awareness at the national level in developing countries of the benefits of market research in food programs,
- To explore ways of establishing appropriate training courses for market researchers in developing countries,
- To develop suitable and reliable methodologies for undertaking market research for social objectives in developing countries, and
- To consider the possibility of creating market research and training centres oriented to the problems of the developing world.

This workshop should serve as a first step in promoting these actions, which would result in more effective postharvest research for the benefit of poor people in the developing world.

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MARKET RESEARCH IN DEVELOPMENT PROJECTS

The development project should be an organized application of research and development, production, and marketing techniques to ratify the real wants and needs of the consumer or the end user. This integrated approach will lead to clearer project selection and planning, more efficient project organization, and more successful application of the findings of the project.

Market research is, therefore, an integral part of development and needs to be used. At all stages of the project it is required to understand the environment and define the problem. During the main development of the project, market research is used to test that the project is "on track" and at the last stages to aid the transfer of the product, process, or system into the community or company.

Many marketing research techniques can be applied at different stages of the project — market surveys, consumer surveys, consumer panels, discussion groups, sensory testing, and product testing. These techniques can be applied at various stages in the development of products from an agricultural crop, introduction or improvement of an industrial process for the agricultural crop, nutrition intervention programs, and introduction of new equipment for the rural sector.

The basic agricultural raw materials of any country produce food for the people in the country and also commodities for trade with other nations. In most countries of the world, economic growth depends upon the growth in production of agricultural products.

Technology is making it possible to expand agricultural production and to enlarge on the number of products a country can develop for the benefit of trade and for the improvement of the nutritional status of the people. Technology has also enabled the development of new processes that assist and even reshape the practice of agriculture.

These rapid changes in agricultural technology have meant that there is an urgent need to advance the technology in the postharvest area to obtain better utilization of the increased crops, by developing new products and new processes, improving the quality during storage and the distribution systems, and, most important, introducing successful marketing. In all these postharvest developments there is a need to consider the consumer or the end user. An innovative program for product and process development that includes an understanding of the market will be more successful at directing the development toward a product

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that will be needed by the consumer or any other user. Putting the consumer's needs first in the development process involves the principles of marketing and of market research.

Marketing

Marketing is generally considered to be the practice of meeting consumer needs with a product or service and doing so at a profit. Because marketing is widely recognized among many companies and organizations, and is at least talked about as a concept in other companies, it should be sufficient for our purposes simply to identify the major parts of marketing any product. The problem is, however, that although the concept is known, it is not always practiced. Development projects may be marketing oriented but often are production oriented. In the following are two New Zealand examples in horticultural development.

In New Zealand, there are several horticultural products that grow well under the climatic conditions, and the most famous example is the kiwifruit. Kiwifruit is marketed around the world according to carefully laid marketing plans and strategy based on consumer research that identifies needs in the marketplace of each country. At present, a need has been identified among a particular target market for fruit at breakfast, and work is under way to plan strategically for kiwifruit to fit that need. This is a marketing orientation — looking to the consumer need; as opposed to the other approach that is virtually "this is what I produce, take it or leave it" known as a production orientation.

An example of production orientation that worries some people in New Zealand is found among the many people who now believe that the next boom in horticulture will be in some exotic new fruit product and rush out to plant without having any idea whatsoever whether consumers overseas will want — or will be willing to pay for — those particular products.

Marketing, or consideration of the consumer need, is an essential part of the life of any product. It involves the *product* itself and the process of development, consideration of the *price* of that product, knowledge of the *place* (or *position*) in which the product will be sold to the consumer, and the coordination of the mix of *promotion* tools that are aimed at generating and increasing sales for the product. These are commonly known as the four "P"s of marketing. It is necessary that all of these are coordinated by planning for the development of any product to lessen the risk of failure.

Need for Market Research in Development

Market research is a tool to assist with decision-making, especially in relation to the development stages and market planning of the product. Research results enable the marketer to make decisions about the marketplace. It is a communication tool between the market and the company, and if the role of research is accepted and utilized, it has been proved to increase considerably the chances for the product's success. The following is an example of a New Zealand market that was substantially increased in size based on sound consumer knowledge and cooperation of all producers.

In 1972, the New Zealand Dairy Board produced and sold cheddar cheese for the domestic market. Factories produced varieties to suit standard consumer taste preferences and these were sold at supermarkets in packages of standard sizes up to 500 g. In that same year, the Dairy Board undertook a comprehensive study of the consumer household market for cheese consumption and found, among other things, that the per household use of cheese was regular but very low in volume. Not much cheese was used in cooking. They developed a market strategy that included all stages from producer to retailer and consumer. The strategy centred on the production of large blocks of cheddar cheese — that is 1 kg in size. By coordinating all the parts of the development with a sound understanding of the consumer, the Dairy Board increased cheese consumption to an average of 1 kg/household every 2 weeks by 1976. The whole project was known as the "Bigger Block of Cheese."

So if market research is such a good tool, why don't more people make use of it in the development and marketing of their products? There are some good reasons why this is the case. It is difficult to determine consumer needs because you have to study attitudes, motivation, and behaviour. The design of research is a skill that requires much more than just asking a few people some questions. Also in many development situations there is a heavy investment in plant and equipment for research and development (R&D) and, therefore, there is often a pressing need to show some results in terms of sales. In these cases, not only market research but also market planning is often overlooked for the sake of earning money quickly. Finally, there is often an assumption on the part of those close to the development of a product that "everybody thinks like we do" and, therefore, there is no need to identify prospective buyers and their own specific reasons for wanting this product.

"Everyone will buy one" or "build a better mousetrap and everyone will beat a path to your door" is another common attitude among developers that means it is easy to forget that you cannot push a new product into the marketplace. There must be a consumer need to pull the product through the system. The absence of a defined need for the product is a failure to recognize the potential of each market target or group as being limited to those who need the product, do not have a substitute, and can afford to pay the price of the product.

The idea that "selling the product is someone else's job and not that of the development team" is an all too common approach to new products' marketing that underestimates the coordination and planning needed for all the elements in the marketing mix. Marketing personnel must be brought in to be a part of the product development team from the start. It is also important to consider cost and time from the beginning of the project and plan accordingly.

A New Zealand study of product development in 20 of the major food companies indicated that product managers blamed some of the following factors for their own product failures (West 1980). Twenty-five percent of companies said the major reason for a recent product failure was because the product did not fill a defined consumer need. Twenty percent said the market segment was too small to support the product, a fact that could have been identified by research well before launch. Another 20% said the major reason for failure was a shortage of raw material to continue production.

In this same period (1978–80), research in New Zealand also indicated that for every new food product introduced to the supermarket over a period of 18

months, only 45% remained on the shelves longer than 6 months. There are other studies to document that the development of new food products is fraught with a high failure risk (Borton 1957). Although the use of market research at all stages in the development process does not guarantee success in the market- place, it is one of the tools that helps to reduce the risk of failure.

There is, therefore, a need for market research in the development of and the market planning for a successful product, but how can it be used in the development process? There should be no doubt about the need to develop products that will fill a consumer need. Market research at each stage of product development will give valuable assistance to both technical and market decisions.

The Development Project and Market Research

In every development project, agricultural or industrial, there are certain stages — a beginning, a middle, and an end:

- The beginning — Setting an aim and objectives; recognizing the constraints; developing ideas; screening the ideas; evaluation of the final ideas; and selection of the specific project (or product or process);
- The middle — The definition of the project (or product or process); determining the variables; setting up the experimentation; testing the agricultural material or the product; experiments on developing the prototype product; optimizing the production, the process, and the product; and final specification of the production, process, and product.
- The end — Testing of the agricultural material or product; evaluation of the total system; redevelopment or product improvement or process improvement; final product testing; technology transfer; final commercial/farm/industrial development; and launching of system, process, and product.

Each one of these stages is important, not only the middle stage, which usually gets the most attention. Before any major development project is launched, it is necessary to study different ideas and to evaluate all ideas carefully before selecting one or two for the experimental development stage. (In the developing world, the first stage is important in view of the social variables and a general lack of knowledge of the environment and the market.) The last stage is also very important because unless the product or system is carefully tested in the final environment and the technology transfer is studied, then there is great likelihood that the project will end unsuccessfully.

This outline is suitable for any type of project — development of a new agricultural cash crop, a nutrition intervention program either using processed products or encouraging crop growing, development of a product for a commercial company or for a farmers' cooperative, development of an improved processing technology. All of these projects have to be related to people — to the farmers who grow, the companies who process, the retailers who sell, the buyers who buy, and the consumers who use the product or agricultural material. Therefore, people must be considered throughout the project and knowledge must be obtained about their attitudes, opinions, and behaviour. This is the role of market research — to obtain information about people, in this case in the total agribusiness system from farm to consumer. Depending on the project, there will be

differences in the type of information gathered, but the general outline remains the same.

All projects need to combine technological research and market research throughout the development. The technical market research must be interconnected and not done in separate compartments. Market research may be carried out by different people from agricultural, nutritional, product, and process research fields, but the work of all must be coordinated and the results must be available at each stage of the development. In the following are some of the questions that need to be asked at each of the eight stages of the development process and how market research can help to answer them.

Developing the Aim and Objectives

In a nutrition intervention program, the first question is "What is the nutritional problem?" There are two aspects that have to be studied: Are there nutritional diseases? What are people eating/not eating? The first question has to be answered by surveys organized by medical professionals and nutritionists, but the second requires a typical consumer survey. This may be carried out by nutritionists or by market researchers. After these questions are answered, then the aim and objectives of the project can be developed.

Similarly, before embarking on an agricultural project, one has to decide what the aim is — to provide more money or steady income for the farmer or both? It is necessary to survey what the farmers are doing now. This may be done by agricultural economists but uses the techniques of market research. Also, if a company or a farmers' cooperative wishes to develop something for a market, then they must study the market to discover a target market or a market segment for which they might develop a product. This may be done by desk-market research or by a small market survey.

Idea Generation

Obviously, there are many ways to fulfill an aim, and it is most important at the early stages of the project that as many ideas as possible are created. There is often a tendency to adopt quickly one "track" for the project and not to look at alternatives.

Certainly ideas can be generated by technological literature research and by idea-creation techniques such as brainstorming and product morphology, but market research can also produce ideas. Products and materials already on the market can be studied, "gaps" in the market identified. Also, the consumers and the buyers can participate in discussions that develop ideas for products. There are immediate needs in a market, but there are also long-term social, technological, and economic changes taking place that may introduce opportunities for new agricultural crops or new food products. Therefore, ideas can be generated by market research using market studies, consumer idea-creation groups, and by surveys on changes occurring in the community. The final research undertaken depends on the money and time available as well as the suitability of the research methods.

Screening and Evaluation of Ideas

In studying ideas, it is necessary to ask: Can we grow/make it? Can the farmer be persuaded to grow it? Can we make it in sufficient quantities and at the right

cost? But we must also ask: Can we sell it at the right price and to whom? Can we sell it in the right quantity? In a nutrition intervention: How popular will the food be? How much can be consumed? How much nutrition will it give? How much education will be necessary for the new food to be accepted?

Therefore, there is a need for buyer and consumer surveys at this stage. For the products and agricultural materials that are to be marketed, enough market research has to be done to determine market and sales potentials and prices so that these can be used as a basis for the economic evaluation. In nutrition intervention projects, one needs to determine how much of the food will be consumed and what difference will the consumption make to the nutritional standard of the population and how the food will be delivered to the target groups.

Setting the Specifications for the Project

In the case of a product, whether for marketing or for a noncommercial nutrition intervention project, the specifications are called the "product concept." In the production of an agricultural raw material the product is described by a buyer's or a processor's raw material specifications.

Product concepts can be developed by consumer-discussion panels. Techniques such as multidimensional scaling, factor analysis, and profile testing can be used to build up the characteristics desired by the consumer in the product (Earle and Anderson 1985). It is important that a product profile, i.e., the description of the product characteristics desired by the consumers, be developed at this stage from the consumer studies — this is often called the "ideal" product profile.

Experimentation

In the experimentation, it is important that the quality of the raw material, food, or product is tested continuously. There is little point in extensive experimentation if it is not leading to a suitable new material or a product with acceptable characteristics. Obviously, it is not always practicable to have the consumers, buyers, or users, test the materials/products being produced at the different stages of the experimentation. Therefore, their requirements have to be specified as chemical, physical, or microbiological standards or as sensory standards that a trained taste panel can follow. There is a need, however, at certain critical stages, both in the agricultural experimentation and in the development of the product, to use consumer panels to test the materials and products.

Profile testing with an "ideal" product standard is a useful technique to use for both the trained taste panels and the consumer panels. It is necessary always to follow all the critical product characteristics throughout the experimentation and not just use simple acceptability tests.

Final Testing

When an acceptable product is obtained, then it is time to consumer test or buyer test. Various market-research methods are used at this stage from a simple consumer test to an in-home test, to a small retail-selling test, to a large test market. The type of test used depends very much on the information needed — is the product acceptable? What price is acceptable? How much will be bought? How does the marketing method affect the sales? It also depends on relative costs and reliability of the different test methods.

For nutrition intervention, one needs to determine if the product will be eaten, how much will be eaten, and does it have a significant nutritional effect in the environment, so testing varies from a simple product test distributing the food in some community centre to an in-home long-term test with sufficient food being distributed for a specific period, to a "growing" test where seeds are distributed to the families. Either simple "quantities used" can be determined or medical and nutritional studies can be made of improvements in nutritional status.

In developing agricultural or marine materials for use in processing factories, it is necessary to test the materials in sample factories and determine if they have the qualities needed by the process and the final product. This is mainly technological research but it has elements of market research as it is necessary to interview the processors. Interviewing surveys are very necessary where small processors such as bakers and butchers are to use the raw materials.

Technology Transfer

If there is to be successful technology transfer, it is not sufficient to just say that the product or raw material is acceptable but one must also determine the best way to market it or to transfer it into the community. Obviously, one must know how to communicate, and it is necessary to have promotional market research to find the best way to communicate. For example, in introducing into a village a new crop for a nutrition intervention program, one has to create awareness of the crop, educate the villagers about its growing and use, give information on the available market and encourage them sufficiently to grow it. This is actually just the same as introducing a new product into a supermarket or a market. Market research using consumer panels is needed to test techniques such as video and television and to test actual "messages" and pictures.

Final Evaluation

Market research must monitor and evaluate the success or failure of the final stages. Were the sales at the right level? Did the villagers grow sufficient quantities of the crop? Have sales continued or slowed down or stopped? Market research may do retail audits, consumer surveys, market surveys or use buyer diary studies to answer these questions.

One can see that market research is needed at all stages of the development project and that the research takes various forms. The skill is to use the right techniques at the right time and the right place so that useful answers can be obtained.

Market Research in a Development Project

New Zealanders are among the heaviest meat eaters in the world. However, meat consumption in New Zealand has been falling steadily since 1979. Pig meat's share is only 13% but in the last 5 years, the consumption of pig meat in New Zealand has increased due in every way to the coordinated use of market research in product development and marketing of the product.

In 1980 the New Zealand pig industry was in serious trouble. Total meat consumption had started to fall, expenditure on meat was declining as a proportion of total expenditure on food, and pork consumption was declining as a proportion of total meat consumption. The New Zealand Pork Industry Board was

buying large numbers of pigs to support producer prices and the production of light-weight pigs for the fresh pork market was uneconomic.

A consumer survey indicated that consumers thought fresh pork was fatty, which it often was, and expensive, which, compared to sheepmeat, was also true. They also had a number of misconceptions about pork. Research showed that consumers thought pork was too rich, that it was hard to digest, that it made you put on weight, that it was bad for the very young or the very old, that it was more difficult to cook than other meats, that it was less nutritious and lower in protein than beef or lamb, and that it carried disease and was not a healthy meat. Consumers also thought that pork was not very versatile, a result of only finding large roasts or pork pieces in the meat cabinets.

Research generated ideas for development by indicating that what consumers wanted was lean, good-quality pork, easy to prepare, could be used in many ways, and was good value for money on a per meal basis. The new product developed after experimentation with producers and processors was called the "one-pig concept" — a bacon-weight pig to supply both the cured and fresh markets. The product was called Trim Pork, (a name determined by consumer research, and the Pork Industry Board undertook a totally integrated marketing campaign aimed at repositioning pork as a lean, nutritious, appetizing and affordable meat that was easy to prepare for many occasions. To do this the technologists produced a wide variety of cuts and named them "Butterfly Steak," "Medallion Steak," "Schnitzel," etc. These were again carefully researched in raw and cooked forms with consumers.

The results of this carefully conducted marketing campaign monitored by research and sales figures were extraordinary. Since the launch of Trim Pork, pig meat sales in New Zealand have doubled and its share of the total meat market has increased each year. Prices to producers have been maintained and the annual domestic production has risen by 10%. Research now shows that the number of consumers who think pork is less nutritious that other meats or poor value for money has been halved. The high cost of this marketing campaign has been well recovered in increased sales and better control of the market by the farmer.

This coordination of technological and market research is always necessary in development projects, but even more today when money for projects is not readily available and when there is a real need not only to improve basic diets in many countries but also to provide new cash crops and new agricultural based products in all countries in the Pacific Rim. There is a very real need to change the commodity products exported in past years to industrial or consumer products that can offer higher and more stable prices. To do this, products must be designed with the fullest knowledge of the market and of individual consumers. Market research is absolutely essential.

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Market Research for Nutrition Interventions

Market research for nutrition intervention should add to the selection and understanding of the target group, the selection or production of the food to be supplemented, and the selection or design of the delivery system. Behaviour and attitudes within the family as well as among the delivery system personnel are critical to a successful intervention. A good design and a proper field trial will start an intervention. Only by evaluation and monitoring will it be possible to improve the ongoing intervention.

Every nutrition intervention assumes a major behavioural and attitudinal role of the child, its mother, the family, and those involved in the distribution system. The awareness of this fact, where psychological and cultural factors are at the root of a working system, will make the difference between a well-designed nutrition intervention and a poor one. This approach is well known among marketing specialists. It answers the question of how to satisfy consumer needs in the most practical way.

The problem is, however, that the needs of the beneficiaries are not usually perceived the same way by "nutrition experts" as they are by consumers. Traditionally, a marketing specialist complies with consumer preference, i.e., adding more sugar to the formula (empty calories), whereas the nutritionist will "tell" consumers what is right for them (the doctor's approach), i.e., add more protein, reduce calories, etc. Unfortunately, these changes will affect the organoleptic characteristics of the food.

It seems reasonable to find a balance between what is acceptable to the beneficiary as well as to the nutritionist. This approach, however, has hardly been used at all in nutrition intervention programs.

Design of Interventions

Regardless of the nature of the nutritional gap, every nutrition intervention assumes that providing nutrients will increase their intake and, therefore, will improve the nutritional status of the target group or will protect the child at risk, provided infection does not impair nutrient utilization (Scrimshaw 1978). The question is simply how the target group might increase its intake. To illustrate the difficulties involved in this question, let us analyze a straightforward intervention: a take-home, supplementary feeding program for preschoolers.

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To Whom

For recovery and prevention, anthropometric and socioeconomic criteria have been recommended, respectively. Unfortunately, criteria for nutritional status, as well as its functional significance, based on recoverability and risk, are not well understood. Most of our knowledge on recovery rates is based on experience with the severely malnourished (Ashworth 1969, 1974; Gopalan et al. 1973; Ifekwunigwe 1975; Olson 1975; Picou 1978) in hospitals and recuperation centres. The few field studies where the beneficiaries covered a range of severity (Gopalan et al. 1973; INUAL 1977; Rao and Naidu 1977) showed that the most serious cases recover faster than mild ones. What is more surprising is that stunted children may also benefit by improving their height to age ratio (Rao and Naidu 1977). These findings show that the range of potential beneficiaries is broader than expected. It is even broader if children at risk are taken into account. The criteria for selecting the target will be based on a cost-benefit analysis and policy option made by governments. Figure 1, for example, shows the cost of feeding children below a given age, as compared to the risk or damage for not covering the nutrition gap at that particular age. One can conclude from Fig. 1 that if resources are limited, the best option is to have an intervention for children below two. The costs involved are not only the food costs, but also the delivery system costs.

What

The nutrients to be supplemented, i.e., proteins, vitamins, minerals, caloric density, and protein/calorie ratio, are still open to discussion (Gopalan et al. 1973; Hegstead 1974; NRC 1977; Scrimshaw 1978; Young and Scrimshaw 1979; Beaton and Ghassemi 1982). The choice of food is constrained by the relative proportions that are missing from the target group diet. By far the most important

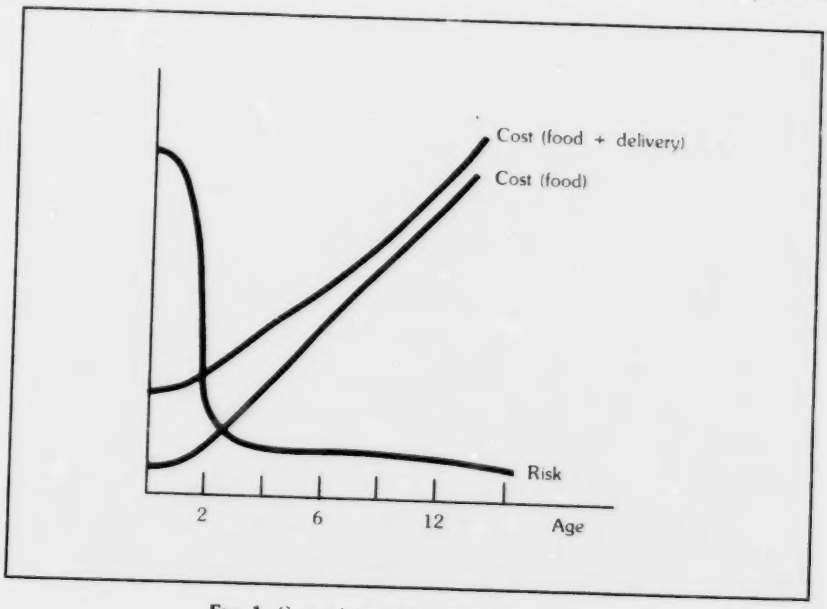

Fig. 1. Cost risk in child nutrition intervention

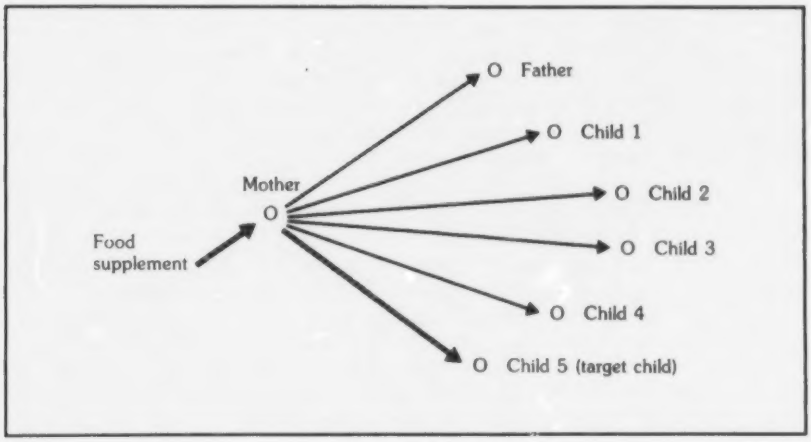

Fig. 2. Intrafamily food dilution.

are the protein/calorie ratio and caloric density: they affect the food functionality and its organoleptic properties.

Some years ago the answer to "what" was thought to be obvious — a weaning food rich in proteins, the more proteins the better. Milk, milk substitutes, protein-enriched cereals were and are used as supplementary foods (Hakim and Solimano 1975; Rutman 1975). Even today, those countries that question the protein gap still use the same foods (Chile, Costa Rica, Brazil).

More concern has been given to the protein quality and quantity than to the food supplement attributes. In reality, food characteristics may be even more important than the nutrient composition in increasing intakes (Lowenberg 1970; INUAL–CITA 1980; INUAL 1985). Intrafamily distribution, food losses, food substitution, appetite, and cooking and cultural practices are related to the kind of food (its organoleptic properties, image, cooking and keeping properties, and caloric densities). This applies even more so if we want to fill a substantial caloric gap, where a variety of food is needed.

There are examples in the literature that show the effect of the type of food: intrafamily dilution was measured in Colombia by monitoring food programs for pregnant women. From oil, bread, and milk, only the latter was successful in reaching the target.

Substitution of the supplement was also detected in preliminary results in the SAWS program in Chile. It showed how oatmeal and WSB were more successful than CSM in their impact on the malnourished (intrafamily dilution might have been the main cause) (Fig. 2) (INUAL 1977).

The type of food might also affect the appetite. In addition to organoleptic properties, high-caloric density foods actually increase the total caloric intake (Ashworth 1974; Ifekwunigwe 1975). Children prefer liquid to solid foods.

A market test was done in Costa Rica among children 2 years of age (INUAL–CITA 1980; INUAL 1985). It was a take-home system where different types of foods were tested (Fig. 3). A rice cereal, specially designed for that age

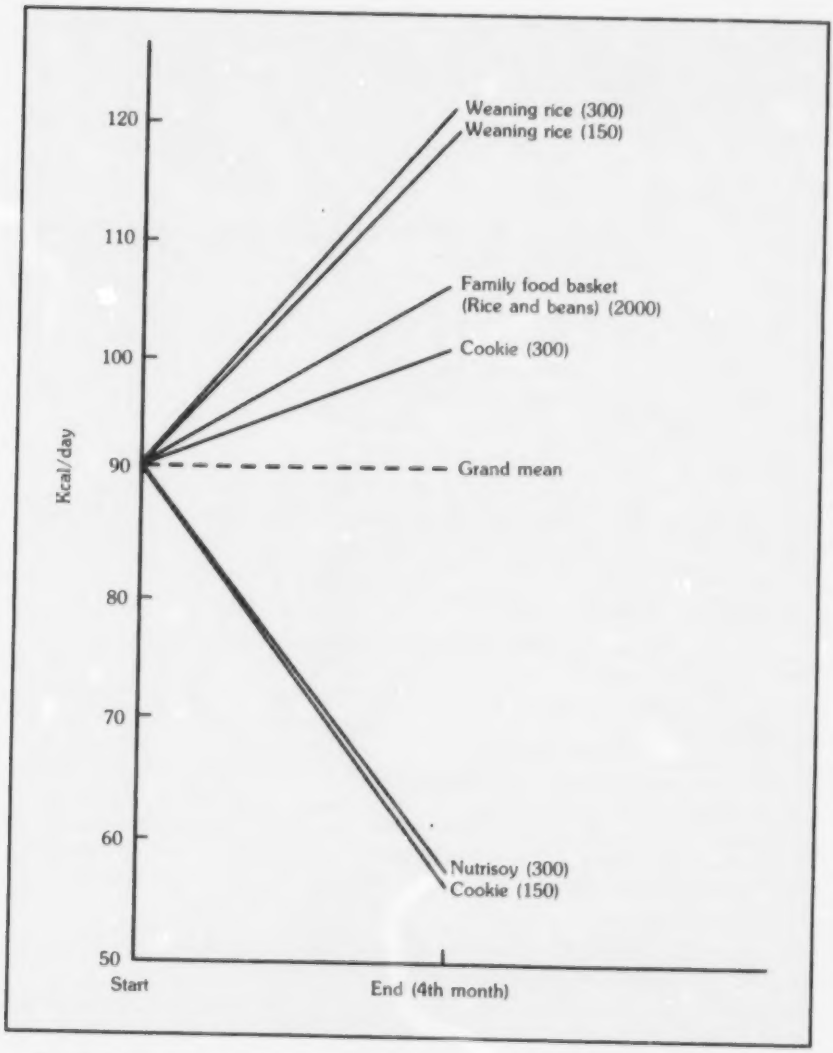

Fig. 3. Energy intake from supplement (figures within parentheses show daily caloric intake).

group in that particular cultural setting, proved to be the best choice when compared to a family food basket, a cookie, or a donation weaning food.

What makes this experiment very interesting, however, is that the rice cereal concept was developed from anthropological and psychological studies done at the same community. Those studies showed that a white weaning food based on rice has a very high chance of success. The cookie was developed as a highly acceptable snack food, nutrisoy in a corn-soy blend, and the food family basket is based on staple foods. The outcome of this experiment showed that the rice cereal was much more effective than other foods. Some 2000 calories of rice and beans

increased the caloric intake of the target child by only 105 calories, whereas only 150 calories of the weaning rice increased the calorie intake by 120 calories. Neither the cookie nor the nutrisoy were efficient: nutrisoy because of poor acceptability; the cookie because of excellent acceptability, but by the whole family.

How Much

Only recently, and mainly because of the new emphasis on calories, has concern about the quantity of the food supplement been expressed. Today, the quantity of supplement is based on dietary surveys plus some arbitrary factor that allows for dilution. This approach is increasingly being used by experienced planners. More often, the quantity is fixed arbitrarily, based on the traditional concept of "a glass per day" or "1 kg month" of something. The quantity of supplement to be delivered should be based on the biological nutrient gap of the target individual, on the one hand, and on the distribution leakages, on the other.

The biological gap is calculated from a comparison between actual nutrient intake and recommended necessary intake. Intakes are hard to measure. The most popular dietary survey methods are not too reliable (Miller 1970; Lechtig et al. 1976). Recommendations based on requirements are not yet well known (Hegstead 1974; Payne 1975; NRC 1977; Young and Scrimshaw 1979); therefore, the actual intake gap is not known either.

Distribution leakages by and within the target family, although discussed and documented, have been hardly quantified. The scanty work found in the literature is based on expenditure surveys (Reutlinger and Selowsky 1976), dietary surveys (Miller 1970; Flores et al. 1973; Lechtig et al. 1976), and a very few studies utilizing nutrient tracer techniques (Latham et al. 1971; Rush et al. 1974). Unfortunately, when the method provides quantitative data via surveys, there are questions of reliability and subjectivity of the measurement. On the other hand, tracer techniques that are objective, are difficult to apply. We might conclude that because neither intake gap nor leakages are fully known, it is, therefore, not known how much food is needed for delivery to the family so this should be determined through further study.

There are several examples that suggest how quantity matters. In Chile it was shown how substantially increasing the amount of calories provided to malnourished children has a considerable impact on their recovery rate as well as on the protection of those at risk. Furthermore, each additional kilogram of supplement increased the recovery rate as well as the number of those recovered. Findings in India illustrate the effect of calorie supplementation on increase in growth rate even in the presence of infection (Gopalan et al. 1973; Rao and Naidu 1977). The high recovery rate observed in Colombia (Wray 1978) was very similar to the Chilean findings, and the amount of supplement was quite substantial. Furthermore, a diminishing rate of diarrhoea among the supplemented children was observed. A dramatic recovery rate of the severely malnourished and impact on survival as a result of the provision of calories were also observed when skim milk was substituted for a high-caloric density formula (Ifekwunigwe 1975). The Costa Rica experiment shows how quantity is affected by the type of food, therefore, more will be needed when there is intrafamily dilution, as shown by the supplement of cookies in Fig. 3.

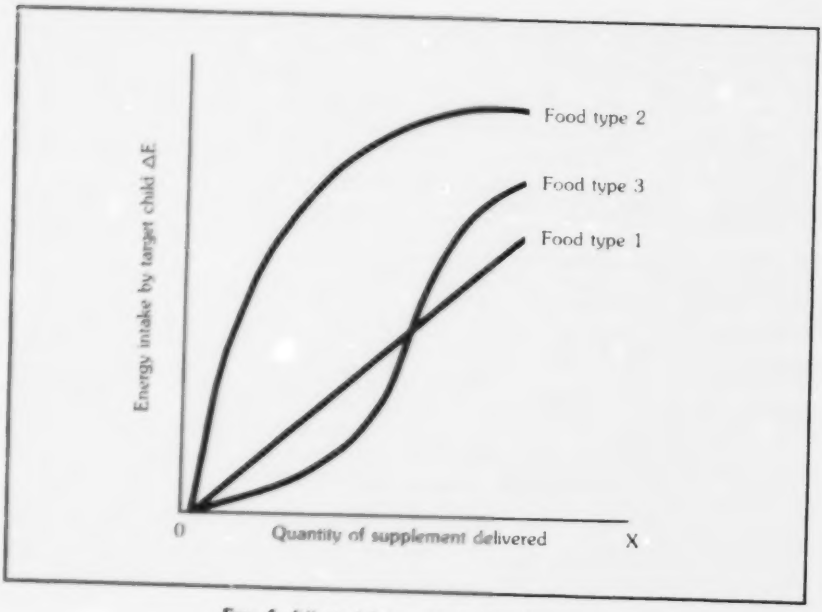

Fig. 4. Effect of the quantity of supplement

Figure 4 shows how the quantity supplemented to the family would increase the target child calorie intake. Food 1 is well targeted and shows an immediate impact on intake; food 2, however, is intrafamily diluted and only at higher levels of supplementation reaches the target child. Food 3 has a poorer performance than food 1. If we compare Fig. 4 to Fig. 3, it is possible to see how the cookie corresponds to food 2 with a high intrafamily dilution and food 1 to the rice weaning food.

When

When the supplement should be delivered is not clear at all. Normally, it is supposed to function the year around. One might, however, expect a major need during drought, famine, and, in general, during the more high-risk seasons. We might even think of a seasonal flux of supplementary feeding programs as an attractive intervention. Sometimes it might be better to provide more for a short time to catch up (Ashworth 1969; Ifekwunigwe 1975; Olson 1975; Picou 1978) than to provide less for a longer period.

How

Food could be distributed through the market system, via price adjustment (subsidies); ration shops; community participation; existing health, agricultural, and educational systems; or ad hoc through specially designed delivery systems. Which system should be used depends very much on the country's political, economic, and logistical characteristics (Foxley and Raczyneki 1984). The chosen target will also suggest the delivery system. Health care systems have been utilized. However, in few countries is the health delivery system sufficiently large to permit the needed coverage.

Actually, all the questions highlighted so far cannot be treated separately, i.e., the type of food and its quantity, as well as the target group, will define the delivery system. The target group, its age, severity of malnutrition, and the cultural characteristics of the family will have an effect on the kind of food needed, i.e., if oil is used, there might be difficulties both in the delivery system, because of prices, and in the family, because of its cooking potential. We might guess that milk might have more difficulties in the distribution system than within the family (Anon. 1978; Rutman 1975). As might be expected, most of the analysis for this example will also apply to other nutrition interventions, and similar problems are raised in answering the same question of to whom, what, how much, when, and how.

Operationally, nutrition interventions have been poorly designed. There are historical reasons for this. Most of them started as political programs (particularly supplementary feeding) or they were based on agricultural surpluses of developed countries. Success was measured by the tonnes delivered, more than by the number of children who recovered from or were prevented from experiencing malnutrition. Although the most sophisticated technology has been developed for new proteins, the design of delivery systems, management of programs, and overall operational designs are still extremely naive.

A new approach that has become popular in the last decade, is called "appropriate technology," where a technology specially suited to village-level needs and resources is developed to help produce the needed food. This approach, although attractive and apparently simple, still has the same problems as food supplementation and requires a strong marketing effort.

Field Research

Only well-planned field experiments will help in the design of interventions. It is not the purpose of this paper to provide guidelines for field experiments; however, it would be useful to comment on some "do's" and don'ts."

To know the target group and its surroundings is fundamental. It is best to start by detailed interviews of the beneficiaries with the help of psychologists, nutritionists, and sometimes anthropologists, and only then to start surveys, which will then validate quantitatively some previous hypotheses. It is also extremely important to study the delivery system personnel. Those people involved should be carefully studied, especially their attitudes and behaviour toward the mother.

The experiments should be simple in design. Too many questions delay the analysis and make it very difficult to monitor the outcome. Experimental and control groups should be random wherever possible. The best way is to experiment on an existing nutrition intervention program to improve the existing system.

Monitoring and Evaluation

In most countries, the design of the system is done only once, normally by some research institution, and then applied by government agencies. Evaluations are seldom done, which impairs any nutrition intervention. Those interventions might work by chance, not by a systematic approach.

It is only through monitoring that a good working system could be developed. Then it would be possible to follow up the extra- and intrafamily food distribution,

the actual food intake, and, finally, the nutritional impact. In addition, it would be possible and desirable to monitor exogenous variables that might affect consumer response.

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Market Research for Grain Postharvest Systems

Rice postharvest researchers in Southeast Asia have started to appreciate the important role of market research in research and development (R&D) efforts to minimize grain losses. Past experiences have shown that loss-reducing postharvest technologies developed through research programs in the region or those adopted from developed countries gained limited acceptance among their intended users because no ex ante market studies were conducted. Market research is relevant because it provides a complete understanding of the requirements of the system in which a loss-reducing technology will be developed and introduced. It helps to ensure that the technology will fit the conditions in which the client exists. Factors that are considered before postharvest technologies are developed or introduced include the following: (a) the rice farmers' or millers' financial limitations, (b) volume of paddy or rice being handled, and (c) presence or absence of market incentives to encourage the adoption of the technology, among others.

The incorporation of market research in R&D activities has necessitated that postharvest research teams be multidisciplinary to include economists, sociologists, and other relevant professionals. The issues have become so broad that they are now beyond the capacity of a single researcher. Coordination among relevant disciplines should start at the research planning stage so that variables that must be considered in the study are identified early enough to produce an integrated research framework. A common error in market analysis is the tendency to concentrate on a single market segment. This provides a myopic picture that usually leads researchers to make wrong recommendations and, thus, must be divided. A broader systems approach is encouraged.

There are approximately 36×10^6 ha of arable lands in Southeast Asia, 78% of which is used for growing cereals. "Three quarters of the central area is used for rice," the dominant and staple food in this part of the world (Russell 1980:1).

To be assured of self-sufficiency in this commodity, efforts were made to increase production through the use of improved technologies, e.g., high-yielding varieties, irrigation and drainage, and fertilizers, and partly through the increase in areas planted to rice. All these efforts proved to be a success as rice yields gradually increased. Consequently, the market for milled rice has developed over the years to support the fast-growing production sector. The increase in marketa-

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ble surplus necessitated the development of new infrastructure systems, the increase in marketing and rice-processing facilities, and the increase in the number of rice businessmen (Manilay et al. 1985:2).

As the volume handled by the rice marketing system grew, postharvest loss problems also escalated to levels that are substantially greater than they were under the traditional rice market (Russell 1980). These problems are likely to become "increasingly important as production limits are reached due to limited availability of arable land, irrigation water, and other inputs, and as conservation of crop produced increases in economic importance" (Russell 1980).

The respective governments of the countries in the region have encouraged programs to minimize postharvest losses. Measures taken included the introduction of loss-reducing technologies from developed countries. Artificial dryers and bulk-storage facilities are examples of such technologies. Research and development (R&D) programs within the region were also undertaken with the same objective of developing technologies that will provide solutions to the problem of postharvest losses. The 2-t flat-bed batch-type dryer is a product of R&D in the Philippines with the intention of making available a small-capacity dryer to rice farmers. To stimulate adoption, extension programs were initiated where postharvest equipment was placed in the field. But these projects were largely implemented without the benefit of an a priori market research that could place in proper perspective the economic requirements of the system, appropriate social values, the interacting institutions, and the flow of consequences from the interaction to ensure successful intervention, and have met with limited success (Russell 1980; Fredericks and Wells 1983). From these past experiences, there is now a growing realization among researchers, extentionists, and policymakers of the importance of market research as a component of R&D to control rice postharvest losses (Russell 1980).

This paper discusses the relevance of market research in the rice postharvest system, selected current knowledge on the rice postharvest system and its implications on market research, and current directions for R&D in loss reduction.

Market research is defined as the accurate identification of the needs and wants of the consumer and the transformation of one's products to the satisfaction of this demand (Uichanco 1973:2). In the context of developing postharvest technologies for adoption to control grain losses, market research may be viewed as the study of the socioeconomic factors surrounding target clients that may directly or indirectly influence their acceptance of a technology. It is easy to infer that the concept of market research applies a systems analysis approach where the changing relationships of technology, preferences, social institutions, and profitability are taken into account.

Market research is relevant for two major reasons. First, the technical efficiency of a loss-reducing technology is not sufficient to ensure total acceptance by its intended users. Needless to say, adoption is also dependent on economic viability and social acceptability. Koga (1982:390–391) emphasized this point when he wrote:

> What is urgently required is an understanding of actual living conditions in the place where changes are to be introduced. The people's own aspirations are the most basic starting point. However much it may be in the national interest to reduce postharvest losses by a certain percentage, no program to do

so can succeed unless it is perceived locally as being closely linked with the people's own concerns. They are not likely to be interested in accepting a program unless it will improve their living conditions.

Second, the nature of postharvest problems vary in time and space. They are unique to the conditions under which they exist, hence they must be "thoroughly diagnosed and understood before the solutions can be presented and tried out" (de Padua 1977:4,8).

Market research, therefore, becomes the first essential step in any R&D undertaking and any extension program. It provides a data base that serves as the basic input in identifying and developing rice postharvest technologies.

Socioeconomic Factors

A sampling of literature on market studies indicates that past efforts to understand the rice-marketing system were not wanting (Mears 1961; Mears et al. 1974; IRRI 1978). Unfortunately, coordination with other research sectors was lacking so that information from the studies was not used in the technical research. This information, however, is important when identifying and developing technologies for the reduction of grain losses in the region and is outlined in the following.

The Farmer

The majority of rice farmers in Indonesia and the Philippines depend on relatively small arable lands for farming. A typical farm in the Philippines ranges from 1 to 5 ha. In Indonesia, the average farm is much smaller, 0.4 ha (Mears 1972:31–33). Available market research literature provides substantial insights about the small-scale farmers in these countries.

The small-scale farmers' requirements and means, for example, are limited and usually require financing for their expenditures. Tenants mostly rely on landlords for loans (Uichanco 1973:4). Buyers of paddy or sellers of farm inputs are also common sources of loans. Government and private lending institutions, however, are now playing an important role.

The farmers' small farm areas limit the amount of their produce, which is usually obligated long before harvest. "Paddy are used to pay farmers' production loans and school fees of their children; and for buying medicines, clothing, and other family needs. Immediate monetary return, therefore, takes precedence among the farmers' list of priorities" (Frio and Manilay 1985:6; see also IRRI 1978:18,25). Any amount left to the farmer is saved mostly to purchase production inputs for the next planting season (MacCormac 1985:7).

Loss-reducing technologies introduced at this level, which would require additional expenses to the farmers, would meet much resistance. The probability of adoption may increase if, and only if, the technology "would result in a spectacular increase in monetary returns" to offset the high opportunity costs placed by the farmers if they spend their limited financial resources to operate these facilities (Frio and Manilay 1985:7; see also Rogers and Shoemaker 1981). A study in India estimated that a 30% increase in revenue is the least required to encourage technology adoption. Whether this figure is applicable in Southeast Asia remains to be proved (Rogers and Shoemaker 1981).

The atomistic structure of rice farming hinders adoption particularly of technologies imported from developed countries. This equipment can usually handle larger volumes than the farmer can but use fossil fuels, which are expensive in Southeast Asia. One direction for R&D, therefore, is to focus on technologies that will suit the capacity requirements of the farmer and will make use of locally available materials for the construction and operation of such technologies. In cases where there are no technologies satisfying the small capacity and low-cost requirements of a single farmer, it is in the best interests of the rice growers "to buy jointly and share the use of machines in agricultural cooperatives" (Koga 1982:389). This initiative should be given financial support by the government.

Rice Millers

There are small-, medium-, and large-scale millers in Southeast Asia. To make the discussion simple, I have combined the medium- and large-scale millers into one group and considered the small millers as another group. It is sufficient to regard small rice millers as those operating single units of small-capacity mills and providing custom services. The larger commercial mills, on the other hand, purchase and process paddy and sell them as milled rice. There are several points that can be reported about these entrepreneurs in relation to technology adoption:

(a) Paddy that cannot be dried on the farm are sold to the larger millers at high moisture content (MC) levels, i.e., 24–26% MC (wet basis). The incidence of selling wet paddies increases during the wet harvest season because most farmers do not own or use mechanical dryers (IRRI 1978:25). With drying shifted to the larger millers, mechanical dryers become essential as qualitative and quantitative losses become significant because of the large volume of paddy handled at their level. A qualitative loss is "a change in the physical characteristics of the product . . . which will reduce the state of excellence of the product" when marketed. A quantitative loss is a "reduction in the mass of (the product) that is available" for consumption (Russell 1980:1). Most of the losses are incurred as a result of the inability to thresh and dry paddy on time, improper storage practices, and carelessness in the handling and transport of the product. The need for mechanical dryers, therefore, is felt most by the larger millers. Large-capacity dryers involving high investment costs have greater potential for adoption at this level.

(b) One of the many factors constraining investment in dryers is the substantive reliance of the larger mills on loans to finance working capital for an increased purchase of paddy (Fredericks and Wells 1983:18). (This was also reported by rice millers in Northern and Central Luzon, Philippines.) It is highly possible that much of the available funds the millers are willing to reinvest in their operations will be used for the purchase of more paddy before these are used to buy new postharvest facilities. Low-interest facility loans, therefore, must also be available to help accelerate adoption of technologies.

(c) The national concern of increasing milling recovery and head rice through the use of improved single-pass mills were and will be met with resistance by small millers who accept milling by-products (i.e., rice bran and small broken rice) as payment for their services. The traditional small mills usually have less than 60% milling recovery. This means about 40% per volume of paddy is recovered as by-products.

Many farmers go to small custom millers to have their paddy milled for home consumption. Leaving the rice by-products as payment is a normal practice.

(Cash is usually scarce.) Millers sell the bran and small brokens as animal feeds. The more by-products they can get, the better is their income. Introducing improved single-pass mills that feature higher milling recovery will decrease mill by-products, thus reducing the millers' revenue.

Consumer Demand and Price–Quality in Milled Rice

There is an apparent lack of interest concerning the quality of milled rice among the majority of consumers in the Philippines. The high percentage of broken and discoloured kernels does not seem to bother consumers (National Food Authority 1983:24). Rice variety and aroma appear to be of more concern (Aspiras 1970:19–22).

The current pricing system for milled rice also gives little importance to qualities such as increased head rice and low incidence of discoloured kernels (Frio and Manilay 1985:5–6). An International Rice Research Institute (IRRI) study reported that, in the Philippine rice market, an increase from 14 to 42% of broken kernels decreased the wholesale price by only 9%. In contrast, the corresponding drop in the Thailand export price was about 32% (Aspiras 1970:22).

As long as consumer preference and the pricing structure remain uncritical of quality, the adoption of new postharvest technologies to improve quality and reduce losses will be hampered. These market conditions do not provide the proper incentives for adoption.

This situation offers relevant implications in the measurement of benefits expected from loss-reducing technologies. The tendency among researchers to place much emphasis on improved grain quality as a factor that increases the economic viability of postharvest technologies must be qualified. Better grain quality seldom finds a corresponding significant price increase in the market. In the case of mechanical dryers, for example, it is more realistic to assume that substantial benefits can be obtained from the increased capability to handle more paddy during the wet season than to assume that revenues can be increased through the sale of better-quality milled rice while leaving the volume of operation constant.

Need for a Broader Systems Approach

Although there is a general agreement on the importance of a market systems approach in loss-reduction programs, the application of such a concept on applied research and extension varies and these are potential pitfalls in obtaining useful and accurate information. A common error in systems analysis is the tendency of researchers to focus too closely on a particular postharvest function and fail to consider relevant external factors. Their analysis becomes myopic instead of approaching the problem "in the context of the broader system" (Shaffer 1968:1443).

For example, in some research to evaluate the feasibility of mechanical dryers to augment the drying capacity of rice-mill complexes, there were cases where the analysis of economic viability was based on the costs and returns of the dryer alone. A limited effort was applied to view the dryer as a component of the larger rice-milling system (Manilay 1983). This approach fails to provide data useful to

researchers when deciding whether or not to recommend investment on the dryer.

The reasons for this are simple. First, the methodology forces a researcher to make assumptions that are not realistic in the context of the milling system being analyzed. Dryers in large rice mills are mainly used to dry the paddy of the miller. On some occasions when the dryers are idle, they are used to dry paddy owned by farmers or traders for a fee (custom drying). In the former, the benefits or income derived from the use of the dryer are not immediately tangible. Instead, they come in the form of increased sales volume resulting from increased drying capacity and to some extent increased income because of better-quality milled rice.

An economic analysis outside the context of the total rice-milling operation makes it impossible to incorporate these types of benefits and forces the researcher to assume that all revenues are derived from custom drying. Although it may be argued that the drying fee can be representative of the other benefits it again leads to an erroneous assumption that increased revenues because of increased sales volume and better grain quality are results mainly of the operation of the dryer and no additional expenses on other related functions were incurred in the process. This leads to the second reason: the myopic approach measures the viability of the dryer per se not the viability of the whole operation with the dryer in place. These are two different things. The analysis in the latter incorporates other related expenses in the operation of the dryer. This may include capital costs for warehouse expansion and for the purchase of additional volumes of paddy, additional warehouse maintenance costs, and additional rice-mill operating costs. With these cost parameters included in the analysis, more realistic measures of profitability can be obtained.

Another example where a broader systems approach can be applied is in the measurement of equipment capacity. In many countries, there exists a significant excess capacity in the rice-business operation. In the case of commercial mills, which purchase, store, and process paddy, operating at full "engineering capacity" does not mean operating at "optimum capacity." Engineering capacity may be defined as "the maximum number of working hours that can be technically operated in a year (Fredericks and Wells 1983:136). A factor limiting full utilization of capacity is the fact that, to remain viable, the mill has to operate at the point of minimum cost (Fredericks and Wells 1983:137). This is represented by the "optimum combination of fixed and variable costs incurred not only on milling but also on the purchase, transport, and storage of paddy and rice" (Fredericks and Wells 1983).

Redirecting Loss Reduction Efforts

The use of market research in the identification and development of technologies triggers some marked changes in the conduct of applied research and extension programs in the rice postharvest system. Some identifiable changes occur in the organization of a research team and the planning of research programs.

Need for a Multidisciplinary Research Team

Many of the significant problems and issues of the rice postharvest industry are beyond the capacity of a single researcher. The growing realization of the

importance of economists and sociologists in loss-reduction efforts places beyond the reach of an engineer the expanded scope of applied research and extension programs. Coordination is needed with other disciplines to deal with the different phases of the problems.

Coordination in Research Planning

Coordination and team work among engineers, economists, and other relevant professions should start at the program or project-planning stage. Economists should not just be "pulled in" when needed during implementation. Coordination ensures that a balanced research framework is produced identifying at the start the socioeconomic variables that must be studied together with the necessary technical information.

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PART II

CASE STUDIES

Get *hard* data. Get it quickly. That's the key. Get market data, of course, but market data from *trying it* with a user as soon as possible. Get technical data, of course, but from *building* a prototype and *handling* it as the real world does, not keeping it bottled up forever in the pristine, sterile, temperature-controlled, dust-free lab or test kitchen.

A Passion for Excellence: The Leadership Difference
Tom Peters and Nancy Austin (1985, p. 133)
Random House, NY, USA. 437 pp.

An Overview of Case Studies in Market Research

Well before the sound and fury of speculation inherent in the development of theories of marketing and market research have abated, farmers, merchants, financiers, processors, transporters, and retailers go about the business of satisfying consumers' demands. The intensity and variety of forms taken by these demands set the constraints for the size and composition of the flow of goods and services that appear in the market chain. There are also fundamental constraints on consumer behaviour that limit or modify the responsiveness of markets to the potential for change. Principally, these constraints are consumer numbers of composition, their wealth, incomes, the relative prices of products and services, and consumers' knowledge of the quality range of these goods and services. The capacity of suppliers to meet consumers' requirements are also constrained. These are not theoretical constructs of merely academic interest, they are the hard facts of survival, efficiency, and profit.

The identification of constraints on consumer behaviour constitutes our first warning that efficient production and marketing require knowledge not only of what consumers would like to do, but we also require information about what they are able to do. That there are gaps in the knowledge and information bases of producers, marketers, and consumers is suggestive of the need for market research. This section of the study presents description and analyses for case studies of food projects with particular market objectives in a variety of environments.

This is no state-of-the-art seminar. It is instead a presentation of some of the work being done in markets in developing economies. (With the exception of Roy's work, all of the studies have received support from IDRC.) The value of the studies presented here rests in identification of the difficulties encountered in project planning and implementation and the gaps that are acknowledged in our understanding of markets for new products and processes. The value of market research techniques presented in the early part of this volume can be seen as a useful adjunct to standard economic and econometric research in the improvement of our knowledge of how new markets may be developed or existing markets made more efficient in meeting consumer demand more precisely.

Roy identifies market research as a tool that enables the provision of "appropriate" products and technologies. He sets up a framework that relates technology, production, and markets; identifies the rural–urban nexus; and the inter-

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and intrasectoral flows of products and services and by implication the flow(s) of information. One might take issue with his observation that the applicability of market research and analysis might be restricted for traditional products. It may be rather important to understand the characteristics of the traditional set of products and services to ease the path of evolution of new, unconventional products or inputs. The principal focus of Roy's study is the provision of a framework for market research about food and technology. This he does with real insight and panache.

Roy is concerned to produce a framework in which market research as presented to the workshop might broaden its traditionally urban orientation so that it might be effectively applied to marketing problems in the rural areas of developing countries. Sensibly, he restrains the impulse to surround the problem on all fronts and begins with a classification of market transactions and some examples of products and processes that are potentially viable innovations in the rural sector. His first "working" example of a small-scale innovation — biogas as a cooking medium — highlights the importance for project success of product and process characteristics, income and price, and the flow of information about them. His treatment of the allocation of time in farms/households is suggestive of ideas that Stigler and Becker (1977) have explored with respect to tastes, time, and human capital. Here he is concerned with cottage-industry developments for the sale of rurally produced handicrafts to urban centres. In this sector of trade he also lists agroindustrial products and processed agricultural products. The final relevant segment, the urban to rural sector of trade, is, as one might expect, the major sector. Roy canvasses the market research necessary to support sales of products that are produced at large-scale levels and have dispersed markets such as agricultural implements, textile machines for use at the household level, cooking stoves, machines for mudblock production, solar devices, and windmills. His representation of demand is schematic rather than analytical and is buttressed by what is effectively a summarized checklist for the market researcher.

Gaps in choosing and implementing appropriate technology are seen to arise from deficiencies in information where the gains are not apparent, weaknesses in market informational institutions, and identification of appropriate product or process characteristics. Roy assures us that market research in the developing world is alive and well, and the studies of the workshop attest to this view.

Dow Mongkolsmai's study, "Supplementary Foods in Rural Thailand," is in a way a companion piece to the paper by Pushpamma. This study too is concerned with supplementary feeding of children. The study is also concerned with the implementation of food programs and market impediments to their effective delivery. The author examines the role and the efficiency of the village food processing centre (FPC) as the processing and marketing agent for infant food.

The author also rightly dispensed with information from an earlier nonmarket trial of the product and collected baseline data for the target area on household size and composition, sociodemographic and economic characteristics of the households, production and food consumption levels and composition, household food treatment, and the living conditions and health and nutritional status of children.

A relatively large part (80%) of the target market was surveyed with respect to the knowledge of mothers about supplementary feeding and food procurement practices. The food formulae were tested by potential consumers who were

questioned on their willingness to pay hypothetical prices. Further surveys were conducted on availability, costs, and potential sources of raw materials, methods of product distribution, and supplementary food production distribution and consumption. These surveys and the economic feasibility study are a tour de force of the problems likely to be encountered in product development and implementation of a program for market-oriented food supplementation. Dow sees the principal weaknesses of the program as deficiencies in information flows with respect to nutrition, the products marketed, and deficiencies in convenience and taste characteristics of the products.

Pushpamma in "Supplementary Foods in Rural India" makes more explicit the dual objectives of many studies of efficient food marketing and dietary goals for target groups. The thrust of Pushpamma's study is toward the critical nature of the diet for infants as an input for the development of human capital and as a marketing problem. She stresses the communication gap and the significance of domestic, community, and market constraints on product development. Pushpamma identifies clearly the necessary features of children's diets and the inhibitors to the provision of adequate supplements to breast feeding — dietary information, incomes, socioeconomic status, cultural and religious practices, and household customs and traditions. The success of programs for improved delivery of supplementary foods to infants is seen correctly in this study as depending on marketable products that consumers perceive will meet their socioeconomic aspirations, are affordable, and coincide with the pattern of household activity. Earlier programs failed to meet these criteria. The problem specification and proffered solutions in the study are in classic form. The success of food programs are seen to hinge on an awareness of the significance of product price and quality, consumer budgets, available substitutes, consumer education, and the sociocultural environment. This theme is developed further and extended into the market for technology by Roy in "Marketing Foods and Technology in Rural India."

In the study "Market Needs for Vegetable Drying in Sri Lanka," Curtis and Gunetileke direct attention to tests of consumer acceptance as precursors to market development including identification of characteristics of the product and their acceptability by different market segments and the specific market form (snack foods) where market "success" might be best achieved. The detail and care evident in this study are outstanding. The perennial time, place, and form questions of economics are addressed for dried vegetables with remarkable expedition and insight. The seasonal gaps in the market for fresh vegetables, competition between fresh vegetables and the new dried products are faced, and the authors review the product characteristics and potential domestic end uses (say as a curry or vegetable filling) and their specific market outlet (convenience foods). The nature and effectiveness of the processing required to achieve the food engineering aims and the conduct of the market survey, its goals and procedures, are presented with clarity. We are able to get a well-defined picture of how consumers reacted to the various dried vegetables, ash plantain, bittergourd and drumstick products, and the weaknesses in processing that emerged and consequent deficiencies in product characteristics. The income groups most likely to buy the products were found to be the low- and middle-income groups.

This is the sort of baseline study from which productive development projects can emerge. Directions for further economics research are embodied in this study.

and it is clear that economic concepts can be consistently applied in a full-scale project proposal for market development of these products.

Implicitly, this paper draws attention to the way in which income elasticities evolve with development and give real point to the recent work of Timmer and Alderman (1979) and the earlier seminal work of Harmston and Hino (1970). The static value of income elasticities for dried vegetables is of use, but in development work it is knowledge of their rate and direction of change that provides the real indicators of market potential.

Grain drying technology has attracted increasing interest throughout the developing world. The level of adoption has been uniformly disappointing. Cardino examines this phenomenon in "Grain Drying in the Philippines." She identified the major constraints on adoption of mechanical rice driers as low throughput, limited capital, and the unavailability of dryers. Cardino found the continued use of driers to be inhibited by high fuel costs, poor understanding of the technology, and low-quality output. The case studies she examined confirm the intuitive expectation that success in the use of rice dryers required adequate volume; matching of capacity and throughput; integration of the drying, milling, and marketing activities; technical know-how; and profitability.

The set of recommendations from this study bear repetition. Cardino insists, quite properly, that the drying process must be appraised "as part of the total marketing system." This view is consistent with modern cost–benefit analysis in multistage markets by Freebairn et al. (1982) and Gunawardana and Quilkey (1986). The emergence of market incentives for appropriately graded quality output are identified in this study as a prerequisite for adoption and continued use of grain driers. As well, Cardino suggests grouping of growers to overcome capital constraints and increased extension to improve know-how.

Wiboonkiet Moleeratanond in "Product Information to Improve Small-Scale Food Manufacture in Thailand" tackles quite a different problem to the other papers in this section. His research is directed to the improvement in the processing of a traditional product (transparent noodles) by small firms. The approach to problem solving is to distil the experience of firms into an orderly identification of the relationship between inputs combined with techniques in processing to achieve target quality standards. The heuristic procedure is effectively the synthesizing of the experience of many firms to develop processing methods that will achieve acceptable product quality standards and enable flexibility in the use of inputs. The methodology employed is essentially the pooling of industrial information directed to the solution of well-defined problems in the techniques employed or product quality.

The Pableo and Ignacio work, "Investigating the Marketing System for Groundnuts in the Philippines," is part of the necessary exploratory or descriptive work, an essential component of any research that enables us to identify economic problems in the industry. We can then proceed with some conviction to the development of formal hypotheses and models and the orderly collection of data with which to test our hypotheses about the critical parameters of our market models for each segment of the marketing chain.

As part of their descriptive work the authors surveyed farmers, traders, and processors. Their inclusion of the farm sector is a salutory reminder that marketing and postharvest problems extend back to the producer. In particular, this extends

to product quality, which is affected by on-farm handling, transport, and storage. Here too, pricing efficiency is critical and the authors provide some initial data on the sources and accessibility of price information. They propose buyer collusion and the absence of recognized quality standards as major impediments to market development.

The authors list a number of industry problems that reflect deficiencies in operational and pricing efficiency at all levels of the marketing chain. There are no surprises in the list, which includes unstable prices and collusion among buyers, the lack of a grading system, capital shortage, low product quality, and lack of control of final product characteristics. The authors are aware of the preliminary nature of their investigation and propose an agenda of future research.

The study on fish marketing in Malaysia by Arshad and Gibbons is of interest in its own right, but it provides something of a benchmark. Although the authors concentrate on market institutions and structures they raise many of the issues that emerge in most market studies. The contribution of this study is partly methodological and partly analytical. It stresses the significance of market channels and knowledge about them. The authors concentrate on description rather than analysis, but they provide a number of useful hypotheses about market structure. They confront, head on, the ethnic background of traders and identify the advantages in trading skills, innovative characteristics, and entrepreneurship of the dominant group.

Volatile supply conditions that mark fishing and fish-related industries and the attendant risks have the expected effect of concentration on the buyer side of the market and the development of direct linkages through informal contractual arrangements. In themselves such arrangements can benefit market participants through risk spreading but here there is some qualitative evidence of near monopsony or oligopsony and collusion. The study generated quite a few policy recommendations aimed at greater market management for fishermen and quality improvement for market inputs such as ice, grading standards, and market research. Arshad and Gibbons offer some prescriptions for improved market research in general and for their own study. An improved data bank ranks high on their list. Particularly, they stress the need for data that would enable the product to be traced along the marketing chain from primary producer to the final consumer. They stress concise and precise survey objectives and the need for researchers to muddy their boots with relevant field work and to improve survey management with the accent on data quality.

There is plenty in these papers to provoke a thoughtful restatement of scientific method for market research. In particular, one's attention is drawn to a gap in what appears to be the market research philosophy that markets are demand dominated. Supply seems to attract only cursory attention in any of the studies and even that is confined to an awareness of the costs of various processes in the marketing chain.

In my view, market research for agricultural products must take explicit account of the stochastic supply of agricultural products. Producer and consumer surpluses are augmented or eroded by shifts in supply. The direction of change in these surpluses is conditioned by the positioning of the product with respect to price and the income and price elasticities of demand.

These problems aside, the case studies are evidence of a growing interest and competence in market research in developing countries. The authors and participants at the workshop are agreed that much remains to be done in sharpening the concepts of market research, improving the complementary relationship between econometric analysis and market research, and the explicit treatment of social and cultural influences on market behaviour.

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Marketing Food and Technologies in Rural India

The paper is concerned with the role of market research in marketing socially appropriate products and technologies in rural India. It begins with a taxonomy of the possible production marketing scenarios, each of which is associated with a different category of products. The three marketing scenes are respectively defined by products that are produced and marketed in rural areas (RR), produced in rural areas but marketed in urban (RU), and produced in urban but marketed in rural areas (UR).

In each case, with the help of case studies and examples, some marketing problems are identified and specific market research techniques to help solve these problems are discussed. The tools recommended for rural market research include concept tests, products tests, determining product positions and market segmentation, preproject feasibility analysis, product pricing, and market size estimation. Finally, three levels of criteria to judge marketability of a product based on need, demand, and market are formulated, highlighting the role of market research in correctly analyzing the market and in improving product design.

Market research presupposes a marketing environment with well defined market characteristics and associated marketing tasks. Although the discipline is well developed and widely practiced with regard to products catering to the urban market, its application in the rural areas of the Third World has remained quite limited.

The basic objective of this paper is to highlight the important role that market research can play in solving specific rural marketing problems. The products under consideration are those pertaining to appropriate and innovative technology aimed at the needs of the poorer rural population in a country like India. The approach followed here is first to define and state specific marketing issues and problems and then to specify the role of market research in solving those problems. The accent is not on techniques of research (which are well known), but on careful formulation of the problem. The premise inherent in the paper is that market research is not an end in itself but a powerful tool for dealing with rural products and markets. It provides the essential feedback mechanism needed to close the loop between *innovation*, *production*, and *marketing*. The paper is based largely on the experience gained by the Society for Development Alternatives (SDA) in their activity of producing and marketing socially appropriate products and technologies in rural India.

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Market Research and Production–Marketing Scenarios

In considering different marketing scenarios, three levels — technology, production, and market — have been considered, each of which can be either rural or urban, giving rise to the classification presented in Fig. 1.

The three marketing scenes are defined by products that are produced and marketed in rural areas (RR), produced in rural areas but marketed in urban (RU), and produced in urban but marketed in rural areas (UR).

We are concerned here with all but the "UU" (urban/urban) scenario. This classification is fairly robust and provides for distinct sets of products giving rise to separate problems and requirements, both for production and for marketing and the need for associated market research tools.

Rural to Rural (RR)

The first category represents the class of products and services that are both produced and consumed in rural areas. These products have the following characteristics:

(a) They are not produced on a large scale (except agricultural products). Growth of an industrial activity in a rural area beyond a certain level automatically changes its working force composition and other infrastructural characteristics, converting it into an urban economy.

(b) They do not cater directly to a large rural market. Small-scale production, the low density of population, large distances, and poor transportation and storage facilities are some of the major factors contributing to this phenomenon. For some products, a large-scale rural to rural flow may occur but via an urban area. Without loss of generality, these products can be considered as RU (rural to urban).

Given these characteristics, and the small scale of both production and marketing, there might not appear to be much scope for the application of marketing analysis and research. This is true, however, to a large extent only in the cases of products and services that are traditional. Introduction of a new product or

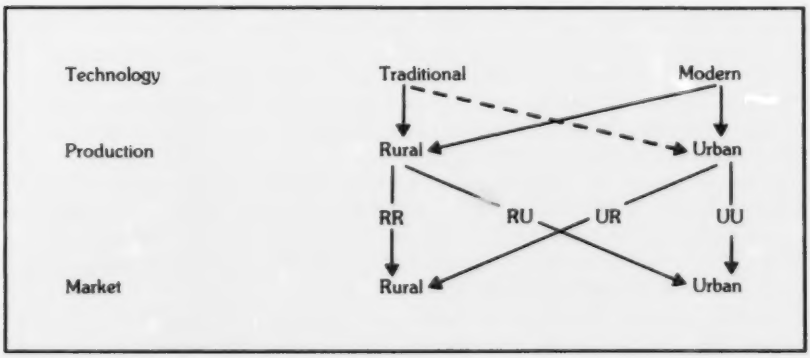

Fig. 1. The marketing scenario — technology, production, and market.

technology raises new issues of marketing that require research. Examples of the products in this category are biogas for cooking, producer gas, kilns for making charcoal, efficient cooking stoves of mud and pottery, and nutritive food supplements.

Most of these products use urban technology and know-how, but can be or are produced in rural areas. Specific problems associated with setting up production and marketing of these products are related to availability of local resources and skills, product specifications, market segmentation, product positioning, and pricing.

Some of the market research tools and studies to help resolve these problems are feasibility studies; concept tests; product tests; and market surveys to determine willingness and ability to pay, profile of potential cunsumers, current practices, and design parameters.

The case of "biogas" as a cooking medium is briefly presented here for illustration. In India, several projects have been carried out in different parts of the country establishing both household and community biogas plants. These have, at best, met with mixed success. Most of these plants turned out to be nonviable operations.

The reasons as determined by recent independent postproject evaluations (1) and (2) include

(a) Unwillingness to pay for the fuel because of adequate availability of alternative fuels, such as firewood;

(b) Absence of a market for plant materials and vegetable wastes in the village;

(c) Low gas production because of water scarcity;

(d) Rise in price of input materials (dung);

(e) Misconceptions regarding health effects and cleanliness of the gas; and

(f) Poorly designed ancilliary equipment, such as gas burners, lamps, etc.

In addition to all these technically soluble problems, the spread of biogas technology has been hampered by the skewed distribution of income within villages and the consequent differential access to water, dung wastes, and skills. All of these are standard production and marketing problems that could have been anticipated and tackled by carrying out suitable marketing research studies. Studies to assess the village resources, paying capacity of the villagers, and potential demand; concept tests for acceptability and willingness to adopt and pay; product tests to determine acceptable characteristics (stove size, etc.); determining the product position (vis-à-vis traditional methods and fuels for cooking); and market segmentation (identifying the beneficiaries) could have greatly increased the chances of success.

The SDA will soon start a project of establishing producer gas plants in villages. The following market research activities are planned, in different phases, the first phase having already been completed.

Phase I: (a) Preproject feasibility — state/national level demand estimation, availability of fallow land, and requirement of raw materials; technical and

raw material requirements; and selection of appropriate technology that can be duplicated in India for wide scale application, and (b) site selection — possible village sites in an identified state.

Phase II: (a) Project feasibility at selected sites and (b) demand and pricing studies at selected sites — for different applications and for different consumer groups.

Rural to Urban (RU)

The characteristics of products manufactured in rural areas sold in the urban market are that these are produced collectively at a number of villages, the production at each village being small. These products are then to be marketed in medium to large quantities in urban areas.

Other than agricultural products, some major items under this are agro-industrial products, processed agricultural products (e.g., sugar), and handicrafts. Most of these are traditional products with already well-established markets and marketing channels. A lot of attention, however, has been focused on this product group in recent times with the aim of creating income-generating activities in rural areas. A successful attempt in this direction also requires systematic marketing research.

The discussion here concentrates on products that generate income-earning opportunities for villagers. Different sets of questions have to be answered for different scenarios. For example, the objective may be to set up small-scale but organized industries or it may be to promote activities at the household level. These are two different objectives and will raise different sets of issues. Regional characteristics will also have a bearing on this. Hill areas or plains, coastal or inland areas will each require different strategies.

There are various schemes of this nature being taken up all over Third World rural areas. Without sufficient market research backup, the success in these schemes can only be incidental. A prime requisite for these schemes is a preproject feasibility study.

A market survey carried out by SDA during 1984–85 illustrates the possibilities. The objective of the investigation was to develop income-generating opportunities for women in some of the hilly areas of northern India. Many ideas for such activities have been explored — from the traditional knitting and stitching to the growing of mushrooms. It was realized, however, that to implement the scheme successfully we must address the terrain. For example, hilly areas with transportation problems, some areas remaining completely isolated during the winter season made it necessary that villages remain self-sufficient. This of course with respect to raw materials and products that can be collected at well-spaced intervals for wide distribution. For the beneficiaries, women followed traditional patterns and were not much exposed to urban life, necessitating selection of products and technologies that, at least at the initial stage, the women can identify with. In other words, we needed answers to such basic questions as

(a) Do women in these areas have time to devote to new activities?

(b) Do they think they have time?

(c) What activities do they believe to be suitable for them?

(d) Are they receptive to new ideas?

(e) What resources do the villages have to start new activities?

(f) What activities could be started without importing alien technologies and practices?

The market survey conducted in two states of Himachal Pradesh and Uttar Pradesh provided us with some important insights. It revealed that the women had in fact more free time available to them than even they thought they had (time disposition analysis vis-à-vis analysis of women's perceptions). There were regional variations. In one state, a large proportion of women exhibited a willingness to learn new skills. Knitting and stitching are traditional activities of women, and the two states did not differ significantly with regard to acceptance of these among women. On the other hand, a new profession of horticulture found more ready acceptance among women in one state than in the other. The village resources, i.e., the abundant availability of some special fruits (citrus, mango, amla), lent themselves to the preparation of jams and pickles, which was even suggested by the village elders.

URBAN TO RURAL (UR)

The products under the UR set make up the largest group among the three. Needless to say, almost all the consumer products fall under this set. Most of the appropriate technology products are also of this category. Some of these products that SDA is currently engaged in planning, manufacturing, and marketing are agricultural implements; textile machines, operable at the household level; efficient metal-cooking stoves; mudblock machines; solar devices; and windmills.

The characteristics of the products under this category are large-scale production and widely dispersed markets. The problems involved here include marketability and marketing of products; more specifically they relate to product specification, market segmentation, product positioning, market size determination, pricing, and distribution.

Some of the associated market research tools and studies are concept tests; product tests; market or desk research to determine, at the regional level, expenditure patterns, disposable incomes, and availability and use of competitive/substitutable products; and market surveys at the village level to determine willingness and ability to pay, profile of potential customers, and current practices.

Two examples follow of the role of market research in "product positioning" and "pricing" carried out by the SDA in marketing fuel-efficient metal stoves in rural areas of India. The efficient cooking stoves were primarily designed to save on cooking fuels. In most of the rural areas, however, fuelwood is freely or relatively cheaply available to the villagers. Traditionally, they also spend nothing or very little on making their own cooking stoves. Therefore, to market a stove that saved fuelwood and had to be paid for did not prove to be an easy proposition. We decided to carry out market surveys. An additional characteristic of an efficient stove is that it produces much less smoke than traditional stoves and takes much less time to cook.

In the hilly regions, the survey revealed that smoke was irritating and tiring for the housewives, so a less smoke-producing stove was an attractive concept to them. Saving time was not so important because they were principally housewives

and did not greatly participate in economic activities. In the plains, on the other hand, smoke reduced the annoyance of insects, so less smoke was not a desirable feature for the housewives. Most of them, however, particularly those in the lower-income groups, worked as agricultural labourers, so saving time was important to them. Yet, in urban areas, where fuel must be paid for, saving fuelwood was an important selling proposition. In other words, marketing research produced, for the same product, three different marketing platforms or product positioning for three different types of regions.

There were other interesting findings. The metal stove, for example, can be initially marketed only as the second stove for the household. In many states, efficient cooking stoves are now being sold by the government at a very heavy subsidy. The survey revealed a latent demand, giving rise to a hypothesis that perhaps the stoves may be sold on a full-cost recovery basis by spending a portion of the subsidy amount in marketing and promotional efforts.

The pricing study was fairly elaborate. We conducted several market surveys (MR) and analyzed available data for desk research (DR). These included the estimation of expenditure on fuels (MR and DR), disposable income (MR and DR), current expenditure on similar or substitutable products (MR and DR), fuel savings from adoption of the stoves (laboratory and field tests), opportunity cost of cooking time saved (MR and analysis), availability of fuelwood (MR and DR), and willingness to pay (MR). Making different assumptions of payback periods (in terms of fuel savings only), we generated price elasticity of demand curves for the product (Fig. 2).

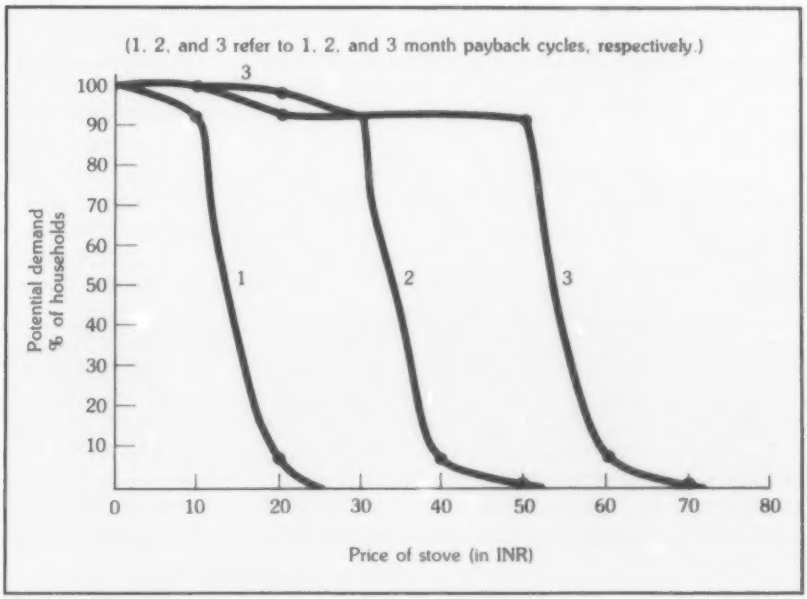

Fig. 2. Price elasticity of demand (12.5 Indian rupees [INR] = 1 United States dollar [USD])

Figure 3 presents the three scenarios and the scope of market research in each. Although some of the tools appear common in two or more scenarios, there will be considerable differences in application. For example, the most common element between RR and UR is that both of these have markets in rural areas. But, although in the former case the market research must help in estimating parameters, say a set of product specifications, acceptable to one or, at most, a few, villages, in the latter case it may be necessary to arrive at a number of sets of specifications, one set for each group of villages. Alternatively, because of economies of scale of production, only one set of specifications most acceptable to the entire group of target villages may be required. Similar differences in scale and scope in the feasibility studies will be observed between RR and RU, both of which have production points in rural areas.

Market Research to Improve Product Marketability

In the field of appropriate technology, a large amount of research and development activities is regularly and routinely carried out in developing countries and in the rest of the world. A major proportion of these activities lead nowhere, remaining ultimately confined to academic publications and drawing

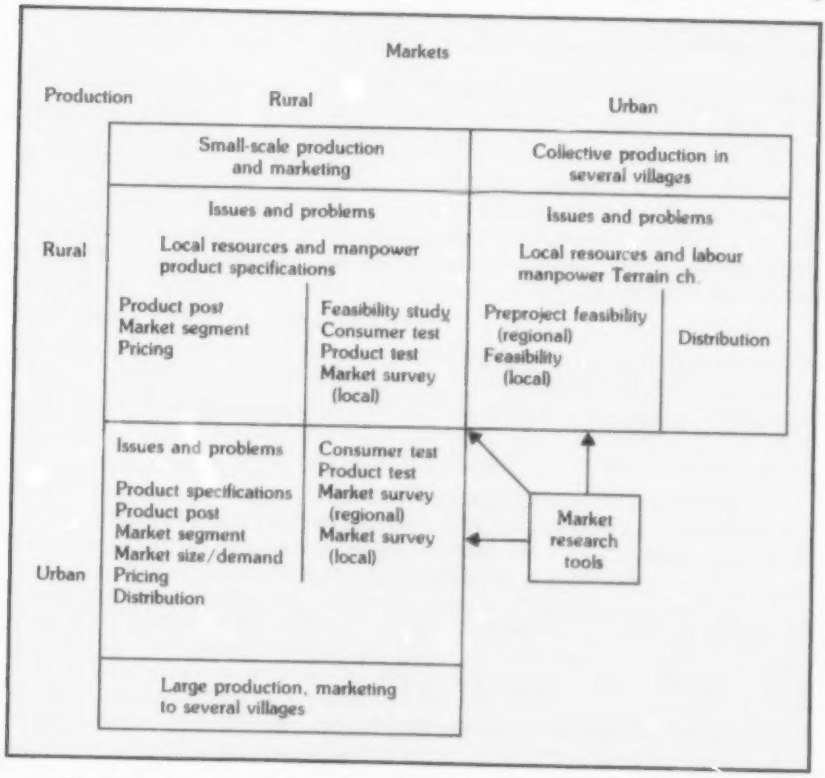

Fig. 3. Predominant marketing problems and associated marketing research tools in different scenarios.

boards. Others are taken up more energetically and enthusiastically and followed up through manufacturing and marketing activities, but finally end up adding to the already high infant mortality rate of technologies in the developing countries. A large proportion of these can be attributed to nonexistent or faulty marketing analysis carried out on these products with inadequate marketing research to back up the efforts. Broadly, three levels of criteria are suggested and discussed in the following to judge the inherent marketing potential and characteristics of a product. It is, of course, assumed that any product, technology, or idea is mooted or introduced with a reasonable expectation that it is needed, otherwise it has no business being there.

Need But No Demand

The standard distinction is made here between need and demand. The efficient cooking stove can be cited as the classic example of this category. At a national level, the need for a product that conserves the forest reserve is self-evident. Given the traditional practices and availability of free or cheap firewood, however, it is difficult to generate demand for a stove that has to be paid for by the individual. Market research must step in here to find the means to generate demand for the product (see the earlier discussion on determining product positions for cooking stoves). In fact, in most cases of appropriate technology, the first step is to generate demand, and market research remains the most effective tool to help create promotional efforts.

Need and Demand But No Market

After ensuring that a demand exists for a product, the next step is to create a market for it. Quite often, although there is an established demand for the product, the market does not exist. Market research can play a significant role in creating a market. If the problem is associated with supply, i.e., related to production or distribution, research can identify the location of raw materials, select project sites, or identify manufacturing facilities and marketing channels. Finally, it can identify the buyers.

Mud block-making machines (e.g., BALRAM created by SDA) are examples in this category. Mud is the most readily available and economic resource, as well as the traditional building material. Mud blocks are economic but are also vastly better (stronger and more durable) building materials than many other materials. There is a demonstrated demand for them at the household level. But who will buy the machine to produce them as it is capital intensive?

Although the machine has been in existence for decades, it has not met with success because there were no buyers. A survey by SDA revealed buyers, such as village panchayats (i.e. local village administrative unit), cooperatives, and masons. They need proper information and backup. In other words, it was simply a problem of proper distribution and not of product acceptability at all. The market research in this case even identified marketing strategies for different types of buyers, e.g., terms of purchase, additional information kits (housing designs and architecture, scheduling of operations, etc.), and so on.

Need, Product, and Market But No Product

The heading "need, product, and market but no product" appears to be a contradiction in terms. The problem here, however, is of the most subtle kind and

Table 1. Urban versus rural — a comparison of some major demographic, social, and economic parameters relevant to marketing.

Parameters/issues	Urban	Rural
Exposure	High	Low
Lifestyle	Modern	Traditional
Period of stay	Short	Long
Daily practices	Fast changing	Slow changing
Social mobility (India)	Yes	No
Resistance to change	Low	High
Adoption mechanism	Imitation	Demonstration
Population density	High	Low
Occupation	Industry, trade	Cultivator, ag. labour
Income distribution	A large group of middle class (typical consumer product user)	A small proportion of middle class
Occupation period	Round the year	Seasonal
Time available for inquiry	Short	Large
Time needed for inquiry	Short	Large
Basis for new products	Consumerism	Development (basic needs)

more marketable products have failed because of the inability of marketing personnel to understand this criterion than for any other reason. The question is whether the marketed product is the same as the one that was needed, demanded, or for which the market existed?

The example of biogas, cited earlier, will serve as an illustration. In the village, the stove that was supplied with the gas connection was of the wrong size to cook the staple food of the villagers. Biogas was needed, demand for it was established, the market consisting of household buyers also existed, but the product — gas and stove combined — was wrong.

This brings into focus the role of market research in product design. Market-research intervention becomes a crucial input to translate a product idea into a tangible product that becomes acceptable and, therefore, marketable to the rural population. For a country like India with large regional variations — socio-economic, cultural, lifestyle, food habits, language, etc. — this perhaps remains the most important criterion. A product, a style, a taste, a particular characteristic that is acceptable in one place may be completely unsuitable at another. A product, to survive and be successfully marketed, must be adapted to man's requirements as much as man adapts himself to nature to survive.

Market research thus helps close another loop in the lifecycle analysis of the product. In the academic shelves and corners of laboratories, there exist today a large number of ideas, technologies, and products appropriate for the rural areas of the developing countries. It would, of course, be an exaggeration to say that lack of market research is the only impediment to their successful market penetration, but if these products are to see the light of day, an essential first step is certainly to carry out the lifecycle analysis of these products with the help of marketing research.

Table 2. Consumer products versus innovative/appropriate/developmental techniques, products, and services — a comparison of marketing and research tools.

	Consumer products	New technologies
Production/marketing		
Need/reason	Profitability	Equity
Major requirements	Capital, land	Local resources
Benefit	Independent of space	Must benefit local people
Marketing issues and research tools		
Product/concept development	Group discussion	Anthropological
Market potential	Surveys, store audit	Inquiry
Promotion	Advertisement	Demonstration
Pricing	Willingness/ acceptability analysis	Affordability
Products	Branded	Unbranded
Sampling		
Respondent selection		
Stratification	Depends	Yes
Sample selection	1st stage: cluster 2nd stage: systematic	Purposive Random
Sample size	Medium to large	Large no. quill, but small no. of H.H.
Marketing Research		
Scope/need	Very high	Very high
Nature	Standard	Interdisciplinary (including economic and sociological tools and analysis)

Urban and Rural Consumer Products and New Technologies for Rural Areas

Tables 1 and 2 highlight some major differences between the two situations. The lists are definitely not comprehensive and are highly simplified.

Marketing research, as developed originally, has been designed for the urban to urban (UU) situation. Transplanting the techniques of marketing and research to the other situations involving rural areas requires careful consideration of the differences that exist between the settlement and the product types.

The same tools remain applicable; after all, market research is essentially an activity to understand the individual and group (community, collectives) forces operating in the market (the common meeting/interacting venue) as reflected in people's attitudes and behaviour and, therefore, should be as applicable, if scientifically applied, at one space time coordinate as another. However, as the axioms differ, a new set of formulations is called for.

Supplementary Foods in Rural Thailand

Market research provides the necessary information to aid decision-making about the system of processing and marketing supplementary food to reach the target group at the lowest cost. It also is necessary to determine whether the village food processing centre (FPC) concept would bring about the desired result. Research results show that production on a small scale at the village FPC was relatively costly and government subsidy is needed if the program is to be successful in producing sufficient amounts of supplementary food for malnourished children. Nutrition education and product improvement, however, as well as regular and effective promotion schemes are needed to create sufficient and regular demand for the supplementary food. More information is needed if the concept of village FPCs is to be used in other areas or under other conditions.

The development and promotion of supplementary foods for malnourished children has been one of the strategies used in solving protein energy malnutrition problems in Thailand since the period of the Fourth National Development Plan (1977–81). During this period, many formulas of supplementary foods were developed, both by the Institute of Nutrition, Mahidol University, and by the Institute of Food Research and Product Development (IFRPD) of Kasetsart University. Experiments had been carried out to test the palatability, nutritive value, as well as safety of the products, but little research was undertaken insofar as promotion and marketing of the products was concerned. The products were mostly distributed free of charge from Bangkok, but supply was irregular and reached only a limited number of children. Some of the products placed in the market for sale did not prove to be popular. As a result, only about 30% of the total requirement was satisfied according to statistics provided by the National Economic and Social Development Board.

In the Fifth National Development Plan (1981–86), the supplementary food program continued, but the emphasis was shifted to community participation rather than a centralized approach. (Community participation is an approach used by the Ministry of Public Health to achieve the goal of "health for all by the year 2000." The approach is used for other health programs as well.) The concept of a village food processing centre (FPC) was adopted. The function of FPCs is to produce the infant supplementary food from locally produced ingredients and to make the food available locally. The Institute of Nutrition, Mahidol University, in an attempt to provide information and lend support to the national nutrition policy, has launched a "Village Food Production and Processing Outreach

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Program" with the support of the International Development Research Centre (IDRC) to investigate the feasibility of producing the supplementary food in a community or a village FPC in the Northeast and distributing it to the other villages nearby. It was expected that the results of such a research program would provide a basis for decision-making regarding the approach and implementation of the village FPC concept on a nationwide scale.

The purpose of this paper is to discuss market research in terms of developing and promoting supplementary food for low-income groups in rural Thailand, using the Village Food Production and Processing Outreach Program as a case study. Before discussing the market research, however, a brief background of the program is presented.

The major goal of the Village Food Production and Processing Outreach Program was to improve the nutritional status of the rural children. The program was implemented in two phases, Phase I during 1979–81 and Phase II during 1982–84. The objective of Phase I was to determine the feasibility of producing nutritionally adequate infant foods in a village FPC. In this phase, the concentration of the program was on the acceptance of the food formulas by the children, the adjustments of the formulas, and the processing method to incorporate the locally available crops and improve palatability, nutritive value, and product safety. The effects of the daily consumption of such food formulas on the nutritional status of malnourished children were also examined.

The objective of Phase II of the program was to develop an economically and socially feasible system for processing and marketing the infant food from a centralized FPC to nearby villages. The emphasis of the program in this phase was not so much on the product itself but more on the marketing of the product. The appropriate questions to ask seem to be what system of processing and marketing would ensure that the supplementary food reached the target group at the lowest cost and whether the village FPC concept would bring about the desired result. In answering such questions, consideration must be given to the demand as well as the supply sides. Hence, market research was conducted as part of Phase II to provide some answers to these questions. It seems reasonable, therefore, to limit the scope of this paper to the discussion of the market research in the second phase, which would be more relevant to the theme of the workshop than the studies of the first phase.

In carrying out Phase II of the program, Nong Hai was chosen as the FPC because the facilities and equipment for supplementary food processing had already been installed during the implementation of Phase I. Moreover, villagers in Nong Hai had developed a certain degree of acceptability and familiarity with the supplementary food and the FPC. The 10 villages where the supplementary food was to be distributed were in Nong Klang. Both Nong Hai and Nong Klang are in the district of the Piboon Mangsaharn in Uboirajtani Province in Northeast Thailand. After some preparation, the production of infant supplementary food in Nong Hai was expanded in August 1982 and the food was distributed to the 10 villages at a price of THB 2 per package of 100 g each (as of 1986, 25 Thailand baht [THB] = 1 United States dollar [USD]).

The following section provides a description of the market research conducted as the program was being implemented. The purpose, methodology, results, and policy implications derived from the research results will be discussed in detail.

Purpose

The purpose of market research is to provide the necessary information about the market to aid decision-making about product development and marketing. In the case of the supplementary food being studied, the required information includes an identification of the consumers or the target group, the acceptability of the product to the consumers, their willingness and ability to pay for the product at various prices, and social factors that may affect consumption. From such information, a decision can be made regarding the method of selling and promoting the product or generating consumer demand for the product.

Because the objectives of the two phases of the program are different, the information obtained from Phase I about the acceptability of the supplementary food formulas and of the FPC in Nong Hai was not sufficient for the implementation of Phase II. Moreover, because Phase I in Nong Hai was launched along with the provision of medical care and nutrition education to the mothers in the village, and because supplementary food was distributed free of charge to all the second- and third-degree malnourished children in Phase I, the results of this phase of the program were unique. The acceptance of the food and the FPC as well as the participation of the mothers either by contributing rice or labour in food processing was partly a result of 2 years of intensive effort in nutrition education and demonstration. Moreover, an improvement in nutritional status of the children in Nong Hai was not only a result of the consumption of supplementary food but also of medical care and nutrition education.

In Phase II, therefore, when the coverage of the program was extended to 10 new villages, new information was needed about these villages because they were different from Nong Hai in terms of nutrition education and other prerequisites. In addition, in Phase II, the supplementary food was no longer provided free of charge. The information from the Nong Hai case was, therefore, of limited usefulness in determining the acceptability of the supplementary food in the other 10 villages. Thus, more research was necessary, particularly in relation to the pricing and marketing of the product as well as in the procuring of raw materials required for production expansion to serve 11 villages instead of one. The economic and social feasibility of the village FPC serving other villages was also to be examined.

Methodology

Collection of Baseline Data

The baseline data of all households in the 10 villages in Nong Klang were collected in April 1981, before the implementation of Phase II. These data include:

- The number of households with 0–4 year old children and the total number of children to determine the size of the target group;
- The sociodemographic characteristics of the households, e.g., education and age of household heads;
- The economic characteristics of the households, including rice production, input use, cost of production, and household income from rice and other sources;

- The household food consumption, food expenditure, food habits, and taboos;
- Food supplementation and food preservation practices; and
- Housing, health, sanitation, and nutritional status of the children.

The baseline data provide the basic information about the consumers and their socioeconomic characteristics to facilitate program and research planning. The data also provide a base with which to compare the situation after program implementation to determine the possible effects of the program.

Potential Market Demand for the Supplementary Foods

The survey was conducted in January 1982 in Nong Hai and the 10 villages in None Klang with the use of a questionnaire to determine the potential market demand for the supplementary food. The sample covered about 80% of the households with children aged 0–4 years in each village. These households included the mothers who brought their children to the monthly weighing sessions at the village health worker's home. The total size of the sample was 401, consisting of 61 households in Nong Hai and 340 in the other 10 villages.

The questions asked in the survey concentrated on the knowledge of the mothers about supplementary food and the means by which they acquired the food for their children. In addition, questions about household income and expenditure patterns were asked again to gauge the household ability to pay for supplementary food. The food formulas were then introduced to the mothers and the preparation method demonstrated. After the children had tasted the food, the mothers were asked how many packages they would buy of each priced from THB 2 to 5. The purpose was to investigate their willingness to pay, given that the children "accepted" or ate the food.

Availability, Cost, and Potential Suppliers of Raw Materials

The raw materials used for the various supplementary food formulas were mungbean, glutinous rice, sesame seed, or groundnuts. The survey on the availability, cost, and potential suppliers of raw materials was made by inquiring at the local retail shops, the urban wholesalers, and from discussions with the district agricultural officers and the farmers' group. The price and transportation and storage costs of the raw materials obtained from the various suppliers were compared, taking into account the quality, service, and reliability of suppliers.

Methods of Product Distribution

Various methods of distribution were considered and compared as to their effectiveness, ease of management, reliability, and costs. The methods considered included a van with video advertisement, village volunteers, the existing food stores in the villages, village health workers, and secondary distribution points. The methods of exchange (in cash and in kind) were also examined. Moreover, the promotion methods, including radio, video, cassette tapes, posters, collecting labels from used products for purchase of free products, as well as the prize for the most efficient distributors were taken into consideration. In addition, the roles of the village leaders, school teachers, and the head monk in the villages were explored as to the likelihood of their cooperation and contribution to the nutrition education and promotion of the supplementary food.

Supplementary Food Production, Distribution, and Consumption

A record-keeping survey began in August 1982 when the supplementary food was first marketed in the 10 villages. The purpose of the survey was to collect monthly data on production and production costs, sales in cash and in exchange for rice, the performance of the distributors and the follow up on the consumption of the supplementary food by the children who make up the target group, as well as the expenses incurred in the distribution and promotion of the product.

To allow consistent observations and comparisons of costs for different scales of production, food formulas were produced in batches of proportionate sizes. A new batch of each formula was produced whenever stock was down to 200 packages, and the batch size depends on the sales in the previous month. To facilitate record keeping for production costs, delivery, sales, stock, consumption, and nutritional status of the children consuming the food, various forms were developed for data recording.

Data Analysis

The analysis of the monthly data collected was useful in providing a basis for planning supplementary food production in the following month. Moreover, problems arising in relation to the sales or food distribution method or other parts of the program implementation were detected; for example, a lack of understanding by villagers about the supplementary food, a lack of responsibility on the part of the distributors, an inadequate promotion effort, a seasonal variation in the sale of supplementary food, or a significant but short-lived response to the development of a new formula of supplementary food.

Economic Feasibility Study

The economic feasibility study involves an analysis of the extent to which the actual production, distribution, and consumption of the supplementary food met with the requirements. This was done by defining the target group (all second- and third-degree malnourished children in the villages) and calculating the amount of supplementary food required per month to meet the calorie requirement of the target group. The actual was then compared with the required amounts. (This was calculated by taking one-third of the daily calorie requirements by age group as the amount of calories that should be derived from the supplementary food and dividing this number by the number of kilocalories provided by each 100-g package.)

An analysis of the cost structure for the production and distribution of supplementary food from Nong Hai was also included. The average variable costs of production for each formula and each batch size were compared. Moreover, the production and distribution costs for production at the much larger-capacity plant in the district were compared with those at the village FPC in Nong Hai. These comparisons were made to determine the location and batch size that would yield the lowest cost per package.

A study on the amount of government subsidy required if the supplementary food was to be produced at a village FPC and distributed to other villages under four alternative specifications of the target. These specifications are:

(a) Free distribution of the supplementary food only to second- and third-degree malnourished children.

(b) Free distribution to all third-degree malnourished children, at THB 1/package for 50% of the second-degree and THB 2/package for 25% of the first-degree malnourished children. (This is in accordance with the target and strategies of the nutrition program in the Fifth National Economic and Social Development Plan to eliminate third-degree malnutrition among preschool children and reduce second-degree malnutrition by 50% and first-degree by 25%.)

(c) Free distribution to all the third-degree cases at THB 1/package, to all the second-degree, and THB 2/package to 25% of the first-degree malnourished children.

(d) Free distribution to all second- and third-degree cases and at THB 2/package to 25% of the first-degree malnourished children.

In addition, the budget requirements for setting up and operating one FPC for 3 years to meet the required supply under each alternative were also estimated. Using the present value approach, the costs were estimated as

$$PV_c = C_0 + \frac{C_1}{1+r} + \frac{C_2}{(1+r)^2} + \frac{C_3}{(1+r)^3}$$

where PV_c = present value of costs, C_0 = initial cost of equipment, C_1, C_2, C_3 = production and marketing costs in years 1–3, and r = discount rate.

In doing these calculations, certain assumptions were made regarding the fixed costs, depreciation rates for machines and equipment, discount rates, and the year operation begins. Moreover, it was assumed that the total amount of the supplementary food produced could be sold to the specified targets, i.e., that there is adequate demand to absorb the amount purchased, the realization of which would require a large-scale promotion scheme and high cost.

Results

Baseline Data

- The target group was identified as second- and third-degree malnourished children and accounted for 82 (11%) out of the total of 735 children in Nong Hai and the other 10 villages.
- Rice farming is the main occupation in these villages, but fishing and hiring out labour in rice farms are important sources of cash income. Because the landholders were small, the productivity of land was low, and little fertilizer was used, rice production by each household was mostly inadequate for year-round consumption.
- The general low level of education in the villages results in a high degree of resistance to change.
- The major part of the diet of the villagers consists of glutinous rice, vegetables, chilli, and some fermented fish. Even very small children or infants are fed with glutinous rice and not much else of nutritive value. Consequently, as many as 10% of the children 0–4 years old in these villages were suffering from second- and third-degree malnutrition, 40% at first degree, and only 50% were normal.

Potential Market Demand

The supplementary food was to be sold at THB 2/100-g package because the greatest percentage of the potential customers indicated that they would purchase more than one package each week at this price. In addition, most of the snacks and candies were being sold in the village grocery stores at THB 2 each, and most mothers purchased these snacks for their children. There seemed to be a possibility of persuading the mothers to substitute the supplementary food for the snacks at the price they were already paying.

Raw Materials Supply

The survey of raw materials suggested that the retail stores in the local market near Nong Hai would be the most appropriate source of raw materials other than rice. Because the amount of supplementary food produced each time had been small, the purchase of raw materials was irregular or disorganized. Even with the plan to expand production, the amount of raw materials required would not be large enough to justify a regular delivery. Furthermore, transportation costs could be avoided because the program van could pick up these raw materials on its regular route. Also, the price at the retail store was not higher than other sources and reliability of supply tends to make the retail store more advantageous than direct procurement from the farmers. Rice, however, was obtained from farmers in the villages.

Product Distribution

- It was determined that village health workers would play a key role in the distribution of supplementary food in the 10 villages. The village workers also have the other duties, i.e., weighing children every month, recording the food distribution forms, and following up on the consumption of the supplementary food by the children. Apart from the village workers, other institutions such as drug banks, health centres, child care centres, and schools were also approached to help promote the supplementary food.
- In addition to cash sales, an exchange of rice for the supplementary food was also accepted at specified rates of exchange. It was hoped that by allowing such an exchange, the villagers with little cash would be able to purchase the supplementary food.
- To provide incentives for the village workers to sell and promote the supplementary food, progressive remuneration rates were offered according to the weekly distribution made; for example, if a village worker sells 20 packages/week he would receive THB 7, but if he sells 40 packages he would receive more than double this amount.
- All promotion methods as mentioned in the methodology section were attempted.

Analysis of the Supplementary Food Production, Distribution, and Consumption

During the first year of supplementary food distribution to the 10 villages in Nong Klang, four different food formulas were produced: sesame (rice, mungbean, and sesame, all ground), ground nuts (rice, mungbean, and groundnuts, all ground), rice (rice, mungbean, and groundnuts, unground), and chocolate (rice,

mungbean, groundnuts, and chocolate, all ground). In the latter half of the second year, a new instant formula (rice, mungbean, and sesame) was also added. The products were packed in 100-g bags.

The monthly production averaged 558 packages in the first year, 744 in the second, and 437 in the remaining 6 months of project implementation in the third year. Production was high (more than 1000 packages/month) during the first 2 months of the introduction of supplementary food into the 10 villages, and then again in the last 5 months of the second year when a lottery draw was used as an incentive to purchase the supplementary food.

The average monthly sales of the supplementary food had the same pattern as its production, i.e., it was higher in the second than the first or third year. Sales accounted for 75, 80, and 107% of production in the first, second, and third years, respectively. During the last 6 months of the program, production tapered off more rapidly than sales while inventories were being used up.

Seasonal variations in production and sales were observed. During the harvesting (October to early January) and planting months (June and July) sales and, hence, production dropped significantly as mothers spent most of their time in the rice fields and had little time to care for their children. Even the village workers went out to the fields during this time. It is noted, however, that these seasonal drops in sales had decreased since the introduction of the instant formula in the 7th month of the second year of the product distribution. This suggests that if the food is more readily consumed, the problem of seasonality in sales can be reduced.

Consumption data during the first year of product distribution show that about 90% of the total number of children who consumed the supplementary food were rated as nutritionally normal or under first-degree malnutrition. About 63% of these children were less than 1.5 years old.

Among the nutritional groups, the second- and third-degree categories had the largest average consumption percentage out of the total number of children in these groups, i.e., 12 and 50%, but the absolute number was 6 and 1, respectively. These large percentages, however, resulted from the small total of 52 in the second-degree and only two in the third-degree groups. For the normal and first-degree malnutrition groups, on the other hand, the percentages of children who consumed the supplementary food averaged 9 and 8%, whereas the absolute number was 30 and 23, respectively. As for age groups, infants 0–18 months had the largest average consumption percentage out of the total: 19% as compared to 7.5% for 19–36 months and 5% for 37–60 months groups.

By nutrition and age groups together, the normal 0–18 months group had the largest consumption percentage (24%), followed by the second-degree 37–60 months group (21%), then the first-degree 0–18 months group (20%). The program had reached less than 20% of the target group of children under the second- and third-degree malnutrition categories.

Economic Feasibility Study

Comparisons between the supplementary food requirement and actual production show that production had reached only about 540 packages/month, or 27% of the required amount. Whereas the average actual distribution was only 21% of the monthly requirement and only 13% of the target group was reached by

the program. This was mainly because the emphasis of the distribution effort was on maximizing sales in each month rather than concentrating on the second- and third-degree malnourished children. It was found that 90% of the children who consumed the food were normal and under first-degree malnutrition. This situation resulted from a lack of follow-ups on the weighing of children and the promotion of consumption of the supplementary food for the target children on a regular basis.

Statistics from the cost analysis show that raw materials and labour accounted for more than 80% of the total variable costs of production. Average variable costs do not change much from one formula to another. The small variations observed were a result of inaccuracies introduced during the manual weighing of raw materials and finished products and from the difficulty in recording the labour time spent on production and processing because the number of people involved at each stage was not constant, especially in packing, and because certain tasks involved joint costs among formulae.

The average variable costs ranged from THB 2.041 for the ≥ 500 batch size to THB 2.186 for the 300 batch size. There was no clear tendency for average variable costs to fall as batch size increased, probably because the largest amount ever produced at any one time was only 500 packages and economies of scale may not have yet been reached at the Nong Hai FPC.

When distribution or marketing costs were added to production costs, the average variable costs were THB 3.52/package. Thus, at the selling price of THB 2/package there was a loss of THB 1.52/package in producing and distributing the supplementary food from Nong Hai to the 10 villages. With an average sale of 417 packages/month during the first 12 months of program implementation, the amount of subsidy by the program was about THB 634/month or THB 7600 / year.

At the district plant, the average variable costs were THB 3.64 for a batch of 500 and THB 2.02 for 1400. The difference in costs lies mainly in labour use, resulting in less than double the labour costs when the batch size almost tripled. Therefore, when comparing production at Nong Hai FPC and the district plant, the same cost per unit at a ≥ 500 output in Nong Hai could be obtained at a larger output of 1400 packages at the district plant. This is because the plant has a much larger capacity than the village FPC and average costs will drop significantly when there is large-volume production. With a requirement of at least 2000 packages/ month, either production at 500 or more packages per week at Nong Hai or 1000 or more twice a month at the plant would yield similar average variable costs.

When the cost of distribution is considered, the transportation cost from the district may be higher per trip but it may be less per package of the supplementary food if large amounts are delivered each trip.

As shown in Table 1, when comparing the four alternative specifications of the target, the subsidy requirement per year as well as the budget requirement for setting up and operating one FPC for 3 years would be smallest for alternative (b) where the supplementary food was to be distributed free of charge only to the third-degree malnourished children, whereas the other groups had to pay. Under this alternative, only 50% of the second-degree group was the target. Because this group only pays THB 1/package, a larger coverage would mean a greater loss, as can be seen under alternative (c) where all the second-degree cases formed the target group.

Table 1. Subsidy requirement (baht) for various alternatives.

	Alternatives[a]			
	(a)	(b)	(c)	(d)
1. Number of children involved	82	121	160	160
2. Supplementary food requirement per month (packages)	2010	3098	4065	12195
3. Production and distribution costs (THB/month)[b]	6030	9294	12195	12195
4. Revenue (THB/month)	—	5078	6045	4110
5. Subsidy requirement THB/year	72360	50592	73800	97020
6. Budget requirement for setting up and operation of one FPC for 3 years (THB)[c]	204650	145600	208550	271540

Note: 25 Thailand baht (THB) = 1 United States dollar (USD).

[a] (a) = second- and third-degree malnourished children only, free of charge; (b) = free of charge for all third-degree, THB 1 package for 50% of second-degree, and THB 2 package for 25% of first-degree malnourished children; (c) = free of charge for all third-degree, THB 1 package for all second-degree, and THB 2 package for 25% of first-degree malnourished children; and (d) = free of charge for all second-degree and third-degree and THB 2 package for 25% of first-degree malnourished children.

[b] Assume production and distribution costs per package could be reduced to THB 3 with larger output (THB 2 for production costs and THB 1 for distribution).

[c] Assume that fixed cost of equipment = THB 7000, depreciation of machines at 10% per year and containers at 20% per year, discount rate of 11% per year (rate on long-term government bond), and operation begins the same year as the setting up of an FPC.

The largest subsidy would be required if both second- and third-degree malnourished children do not have to pay (alternative (d)). This would mean a loss of revenue that could have been collected from the second-degree group, as compared with alternatives (a) and (b) (Table 1).

Implications of the Research Results

The gap between actual production/distribution and requirement is primarily because of a lack of demand for supplementary food attributable to

- Inadequate nutrition education in the villages before distribution. As it is, mothers do not understand the benefit of providing regular consumption of supplementary or other nutritious foods to their children.
- Lack of motivation on the part of village workers or distributors to promote supplementary food. This is due partly to inadequate training of these personnel and partly to inadequate incentives.
- The product needs further development to be as ready to "eat" as possible, e.g., precooked or changed to a form that children can take without further cooking required. Moreover, the taste of the product is also important and needs further improvement. The chocolate formula seems to be preferred by children and sales of this formula have not dropped since its introduction in May 1983.
- Irregular and inadequate promotion of the supplementary food.

Thus, if a similar program is to be implemented on a nation-wide basis, it is important to find out if a demand exists and, if not, it should be created and stimulated. The supplementary food is not a good that consumers normally choose according to income, taste, or product price but it is a "merit" good that government considers beneficial to consumers and, therefore, imposes this value on them by encouraging consumption, the demand for which has to be created for the target groups of consumers. This could be done by various means; for example, through nutrition education, more training of the village workers or distributor of the product, and increased promotion. Moreover, the product could be developed to suit the taste and convenience of consumers, especially during planting and harvesting periods when villagers are in the field and cooking is not convenient.

In terms of the financial implications, cost analysis has suggested that implementation of the supplementary food program by adhering to the concept of community participation and village FPC would require government subsidy. The amount produced is too small to benefit from economies of scale and the government could not charge a high enough price because the rural consumers are poor and cannot afford to pay much more than what they are already paying. Moreover, because the social benefits of an improvement in nutritional status of the people exceed the private benefits, there is reason for government support to ensure the right amount of production.

In the Fifth National Development Plan, the government has allocated some funds for supplementary food-processing equipment and for purchasing the processed food from the villages at THB 2/100-g package. This food is to be provided free of charge to third-degree malnourished children, at THB 1/package to second-degree, and THB 2/package to first-degree malnourished children or others. The initial budget allocated, however, was sufficient to purchase only about 1000 packages per village FPC per month. In the case of Nong Hai FPC, serving 10 other villages, for example, these 1000 packages would satisfy only half of the required amount of supplementary food for the second- and third-degree malnourished children. Moreover, the THB 2/package that the government will pay would just cover the variable cost of production but not the marketing costs. Hence, in carrying out this program, the government will have to bear the cost of distribution as well as the initial purchase of equipment and the subsidy for the second- and third-degree cases.

The market research conducted as the supplementary food program was being implemented provided a realistic response from consumers to the introduction and promotion of the product as compared to those answers obtained from surveys asking hypothetical questions. The results, therefore, also provide a more realistic basis for planning and implementation of a similar nutrition program on a larger scale. It could, however, have produced even more useful results if market research had been conducted before implementation.

The whole package of research plus program implementation, however, was rather costly and time consuming. In addition, some research results may be area or condition specific and may not provide useful implications for a different area or different conditions. For example, the Northeastern food habits, raw material availability, and income level may be much different from the situation in the South or the Central region. Hence, for the development of new products or implementation of new programs, specific information is needed about each potential market under consideration.

It should also be noted that research results depend very much on the accuracy of the data, e.g., on production costs, on the measurements of input use or of the nutritional status of the children. The degree of accuracy required is sometimes difficult to obtain without close supervision of the data-collection process.

Supplementary Foods in Rural India

The introduction of proper supplementary food at the appropriate age has been well recognized as a crucial component of any nutrition-improvement program targeted at infants and children. The unavailability of supplementary foods is often responsible for the late introduction of these foods in India. To remove this constraint, several approaches were adopted for production and promotion of supplementary foods, especially for low-income groups of rural areas. In most of these projects, market research, especially the social, psychological, and anthropological aspects, received little consideration, the main focus being the nutritional quality. In the absence of such systematic market research, many of the programs did not survive or achieve the expected results in improving the nutritional status of the children.

The need to introduce foods not later than 6 months to the human infant along with continued breast feeding has been recognized as the most crucial component in the package of practices for improving child health in all developing countries. Even in the case of mothers who have the best lactation performance, because of the low density of nutrients, especially calories, breast milk, without supplements, fails to meet the qualitative demands of the growing child. The detrimental effects of this lack of supplements are well known.

In India, several studies on the practices of infant feeding suggest that late or even no supplementary feeding is not restricted to the lower socioeconomic groups. Among several factors responsible for such inconsistent/inadequate infant feeding practices are: lack of knowledge of the parents about the food requirements of the child, socioeconomic status of the family, cultural and religious practices, and family customs and traditions. Child feeding practices can be altered by a change in attitude and increased knowledge on the part of the mother who can be greatly influenced by other women who have more education and are of a higher socioeconomic group. Although there are no large-scale systematic studies on changing trends in child-feeding practices, as a sequel to socioeconomic development, it is quite evident that increased awareness and changing work patterns are encouraging the early introduction of supplementary foods in urban areas (Table 1).

Although the magnitude of this change is less evident in rural areas, concentrated efforts of various voluntary agencies and government programs in educating mothers about child-feeding and rearing practices are promising. As a result, the rural mother is now more motivated to introduce supplementary foods. In

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Table 1. Distribution (%) of children by age at which different supplementary foods are introduced by working women of Hyderabad.

Age (months)	Farex[a]	Fruit juices	Biscuits	Bananas	Rice and dal (pigeon pea)	Vegetables and greens
3–6	66	32	15	12	10	7
7–10	33	13	43	41	90	61
10–12	—	2	2	3	10	8

Source: Geervani and Jyoti (1980).

[a] A commercial, milk-based product.

Table 2. Protein-enriched ready-to-eat foods, toddlers and pre-school children at the community and industrial level.

Product	Ingredients
Community level	
Ready-to-mix powder	60 g cereal (wheat, bajari, or ragi), 15 g, pulse (roasted bengalgram), an oilseed, and 40 g sugar/jaggery
Weaning mix	Cereal (cholum, ragi or maize), pulse (roasted greengram or bengalgram dal), oilseed (roasted groundnut), and jaggery
Poshak (a)	Cereal (wheat, maize, rice, or jowar), pulse (chana dal or mung dal), an oilseed (groundnut) and jaggery in the proportion of 4:2:1:2
Poshak (b) least-cost Weaning mix	Same ingredients as Poshak (a) but in the proportion of 60:17:14:9.
Extruded ready-to-eat (RTE) mixture	85 g corn soya milk (CSM) and 15 g salad oil
Keral indigenous food (KIF)	Tapioca rava, soya fortified bulgar wheat (SFB), rava, and groundnut flour
Ready-to-consume (RTC) mixture	Roasted cereal (cholam), maize, ragi, or bajra). Pulse (roasted or sprouted bengalgram, greengram or foxgram), oilseed (groundnut, groundnut/sesame cake flour)
Industrial level	
Baalahar (several plants in India)	Cereal flour, groundnut flour, bengalgram flour, or skim milk powder
Balanced malt food (Mysore)	Cereal malt, pulses and skim milk powder, calcium carbonate, and vitamins
Balamul and Balamul Balamul with milk (Amul, Anand)	Cereal flours, pulses, soya flour, and skim milk powder
Enriched macaroni	Wheat, cassava, peanut and chickpea flour, $CaCO_3$, and vitamins
Farex (Glaxo)	Cereals and milk powder
Lactogen (Nestle)	Wheat flour and milk

Source: Gopaldas (1983).

spite of an increase in knowledge and changing attitudes of the mother about the importance of supplementary feeding, in practice, the situation is far from satisfactory. Some of the planners and scientists attribute this to a lack of supplementary foods in the market at an affordable price to all socioeconomic groups. To alleviate the situation, a number of protein-enriched ready-to-eat (RTE) foods for infants, toddlers, and preschool children have been formulated and some of these are produced on a large scale for marketing in urban and rural areas (Table 2). To the

Table 3. Distribution of children by age of introduction of supplementary foods in the low-income population of Hyderabad.

Age (months)	Biscuits	Chocolates and toffees	Snacks	Roti	Rice	Vegetables and greens	Fruits
6	19.6	1.2	10.0	2.8	—	—	—
6–10	44.0	28.8	81.4	40.5	13.7	17.6	13.5
10–12	24.8	48.0	43.6	53.2	29.4	75.5	32.6
12–18	2.8	22.0	3.3	2.8	7.2	31.4	30.6
18–24	8.8	—	62.7	0.7	49.6	74.5	30.0

Source: Thimmayamma et al. (1979)

Table 4. Age of introduction of weaning foods to children by selected groups of employed and unemployed women of Hyderabad (%)

Foods	0–6 months		6–12 months		12–24 months	
	Employed	Unemployed	Employed	Unemployed	Employed	Unemployed
Fruit juice	70	50	27	40	3	10
Milk	80	47	13	40	7	13
Soft-cooked foods, e.g., boiled eggs and mashed vegetables	60	47	40	53	—	—
Rice and other adult foods	—	—	83	90	17	10

Source: Poornima and Rao (1980)

disappointment of producers, the use of RTE foods was limited to institutions and experimental feeding and did not gain widespread use in rural households. A few of the milk-based foods, like Farex and Lactogen, have occupied a permanent place in many of the households and are used as supplementary foods for infants. Although the rural consumer has been made aware of these supplements through intensive publicity, the high cost of these foods makes them available only to the high-income groups. The analysis of the performance of these foods in the marketplace indicates that only foods attractively packaged and advertised through commercial agencies could make the expected impact, whereas foods like Balahar and balanced malt food, in spite of their low cost, could not compete with the foods produced by large multinational and national commercial firms.

In addition to the advertising techniques, used in the case of Farex Lactogen, the urban high, socioeconomic level consumers who are trend setters promoted these products indirectly by their example when using them for their children. This definitely indicates consumer resistance to social marketing of supplementary foods, unless the same high-status foods are subsidized. In most communities the food one eats is a status symbol and is even more so in the case of infant foods. The psychology of the consumer is usually to prefer the status foods that are used by the higher socioeconomic groups (Tables 3–5).

The use of supplementary foods like fruit juice, milk, and Farex rises with increased income, and the use of low-status foods like dahl, rice, and grains is more or less similar in all income groups. The available information also indicates a definite trend toward reducing the quality and quantity by diluting the supplementary foods when the purchasing power is low rather than purchasing a low-cost supplement (Tables 6–8).

Table 5. Infant feeding practices in relation to income in an industrial workers community of Hyderabad.

Weaning foods	Income groups (INR/month)[a]		
	150–250 (81)[b]	250–350 (107)	350–450 (47)
Fruit juice	33.7	56.8	45.0
Farex	10.1	13.5	74.0
Rice and dal	81.4	47.0	90.0
Mashed vegetables	18.0	13.5	29.7

Source: Anjali Devi and Chittemma Rao (1972).
[a] 12 Indian rupees (INR) = 1 United States dollar (USD).
[b] Figures within parentheses refer to the number in the sample.

Table 6. Supplementary foods introduced between 6 and 11 months of age by different income groups of Tamilians settled at Hyderabad.

Foods (in introduced order)	Percentage of households (per capita income/month)			
	INR 125[a] (21)[b]	INR 235 (14)	INR 370 (17)	INR 740 (14)
Milk	57	76	29	36
Commercial infant food	71	50	59	57
Fruit juice	24	14	12	7
Gruel	10	14	6	36
Banana	33	14	41	64
Greens	24	14	29	29
Rice and dal	57	43	65	64
Vegetables	33	36	59	57
Fruits	14	7	18	57
Curds	14	7	18	57
Biscuits	—	14	6	—

Source: Geervani and Mythili (1980).
[a] 12 Indian rupees (INR) = 1 United States dollar (USD).
[b] Figures within parentheses refer to the number in the sample.

Having failed with the large-scale production of low-cost supplementary foods, it is felt that the most practical way of feeding the child is by modifying the family diet. This will enable the mother to feed the child inexpensively. In practice, however, the family diet is often unsuitable for the young child. To change the family eating habits would require effort, time, and conviction on the part of the mother. In most of the low-income homes, the food is heavily spiced and difficult for the young child to digest. Also, because food is usually only cooked once or at the most twice a day, it is inconvenient to feed the child several times with freshly prepared food. Another limitation with this cereal based soft cooked (boiled) diet is that of bulk. It would be pointless to encourage the mother to feed the child frequently on such a bulky diet (Table 9).

Several nutrition education programs were developed to motivate the mother to introduce a modified home diet for the child with an emphasis on cost effectiveness. The programs were intended to increase the mother's knowledge

Table 7. Supplements given according to age and income levels.

Age (months)	Supplement	Monthly income (INR)[a] 60–200	200–600 (percentage of families)	≥ 600
	Liquids and semi-solids			
0–3	Cow's milk	1	22	86
	Ragi porridge	1	2	—
	Farex	—	1	11
3–6	Ragi porridge	2	3	—
	Horlicks	—	1	—
	Fruit juices	—	11	37
	Cow's milk	41	40	100
	Farex	—	4	33
6–9	Ragi porridge	8	12	5
	Fruit juices	—	12	43
	Skim milk	1	—	—
9–12	Cow's milk	30	49	58
	Skim milk	10	41	—
	Farex	1	4	83
	Ragi porridge	11	4	—
	Rice porridge	—	2	—
	Fruit juices	—	4	93
	Solids			
0–3	Mashed banana	—	2	18
	Biscuits	1	5	16
	Idli	1	—	—
3–6	Plantain	1	1	11
	Biscuits	3	7	14
	Rice	10	7	—
6–9	Idli	2	2	5
	Dal	6	—	9
	Rusk	1	1	—
	Plantain	1	1	5
	Rice	15	15	50
	Biscuits	8	7	50
	Uppuma	1	—	—
	Idli	10	7	33
9–12	Banana, plantain	1	1	75
	Rusk	2	1	—
	Dal	—	2	—
	Dosai	2	3	25

Source: Devadas et al. (1977).

[a] 12 Indian rupees (INR) = 1 United States dollar (USD).

about nutrition and thereby bring about a change in attitude, but the results were not encouraging as can be seen from Table 7.

Even the latest studies indicate that RTE foods are preferred to the home diet. What is needed is to encourage the development of the necessary technology to produce supplementary foods at the community level using locally available foods. Although these foods are locally available, lack of time, fuel costs, and other considerations may not make it possible to produce supplementary foods at the household level. Community-level production and marketing in the rural areas can only promote the supplementary feeding of the child to bridge the nutrient

Table 8. Infant feeding practices in relation to income (the number in the sample = 900).

Age (months)	Food type	High income	Middle income	Low income
0–3	Breast milk	63	68	83
	Fruit juice	15	0	0
	Cereal	2	0	0
4–6	Breast milk	50	60	75
	Fruit juice	33	20	0
	Cereal	11	0	0
7–12	Breast milk	33	65	71
	Fruit juice	55	33	20
	Cereal	50	22	45

Source: Merchant (1971).

Table 9. Common solid preparations used in different areas in South India.

Coimbatore	Gandhigram	Hyderabad	Poona
Rice	Rice	Biscuits	Biscuits
Rice with ghee	Idli	Snacks	Jowar roti
Rice with milk	Dosai	Adult foods	Wheat roti
Rice with rasam	Paniyaram	Rice	Rice
Biscuits	Rice plus blackgram	Dhal	
Jowar kali	Jowar kali	Vegetables	
	Rago kali		

Source: ICMR (1974).

gap between breast milk and the full requirements of the child. Some of the work done on the production of supplementary foods at the community level, like that done on project "Poshak" implemented by CARE in India, have reinforced the need for a thorough study on the marketing of such supplementary foods in the rural areas.

The experience gained in the production of weaning multimixes for children aged 6–36 months with indigenous foods and using village level technology in project Poshak (Gopaldas 1983) although initially encouraging, failed to achieve the ultimate goal. The experiment proved the feasibility and advantages of local production of supplementary foods, in terms of mainly the low product costs and access to the community. The product was acceptable as long as it was supplied free, but families did not buy the same food when it was marketed.

Similar ideas like the Kerala indigenous foods and ready made mixtures proposed by the Indian Council of Medical Research were promoted in rural areas but without much success (Table 2). Again, consumers accepted these mixtures only when they were provided free of charge. This definitely indicates the low acceptability of these ready-to-eat (RTE) and ready-to-mix (RTM) mixtures. Though the claims about their acceptability have been based mostly on the use of these mixtures by the mothers. The product, however, is really only accepted if the consumer buys it in the market when available. There are also several other factors to be considered when assessing the marketability of a product other than its nutritive value. The nutritive value, although of primary importance scientifically, is one of the low-priority characteristics from the consumer's point of view.

Unfortunately, often the only consideration made in formulating these foods is their nutritive value, but along with the nutritive value, the following must also be considered: purchasing power of the consumer, packaging, shelf life, convenience of cooking, viscosity of prepared food, status value, and an awareness of any cultural or religious restrictions.

To include these considerations when developing the product for supplementary feeding, a thorough understanding of the psycho-social structure of the population community is necessary. It is only possible to develop an appropriate supplementary food with wider acceptability when the community is studied thoroughly with respect to local food crops; economic status, with special reference to the purchasing power of the families; food processing procedures; status value of foods; and supply and demand of various food products available in the local market. It is evident from the several alternative trials made that to promote supplementary foods without proper market research support failed to create the demand for these foods. Often, the nutritive value and the cost are the only factors to be considered for promotion of supplementary foods. A well designed market research strategy should include the elements detailed in Table 10.

In addition to the data in Table 10, information at the family level on fuel used for cooking, number of meals cooked, the present infant feeding practices, and the member of the family responsible for feeding of the child, etc., will provide valuable advice for product development.

TABLE 10. Components for a well designed market research strategy.

Market research component	How to use the information
Assessment of existing knowledge practices of child feeding	For developing suitable messages for promoting supplementary feeding
Locally produced food-grains	For selection of ingredients available locally in formulating the supplementary food
Large-scale processing facilities	To identify the suitable processing technology and to introduce a new technology, if necessary
Status value of various foods	To decide in what form the supplementary food should be produced (a very crucial, often missing, factor in most of the experiments on supplementary foods)
Ready-to-eat food products available in the market	To understand the marketability and consumer preferences for RTE foods
— Available but not in demand — Not available but in demand — Status value	Indicates the demand and supply position of RTE foods
Marketing structure in the rural community	To develop a marketing strategy for the promotion of supplementary food
Storage facilities at wholesale and retail marketing points	Helps in formulation of the product
Mode of transport	To decide on the format and packaging of supplementary foods
Purchasing power of the families	To restrict the cost of supplementary food so that it will be within the purchasing power of the target consumer group
Purchasing pattern	To decide on packaging (size, practicality, etc.)
Facilities for storage at the home level	For consideration in developing and packaging the supplementary foods

In several projects, dry mixed supplementary food was given, but this form was not accepted as conventional food. Often these mixtures are considered as therapeutic. It is essential, therefore, to select locally available ingredients and avoid depending on external sources for supply. For community or local production, an appropriate technology is needed to process products that will fulfill the necessary requirements, e.g., economical but attractive packaging; available in small, convenient, affordable quantities; and packaging that will withstand transport hazards and have a long shelf life to ensure the continuous availability of the product.

These requirements vary from region to region so product development must be adapted accordingly. Thorough market research will ensure that the production and promotion of a supplementary food in any region will be acceptable psychologically, socially, and economically.

The benefit of incorporating a market research component in development projects is well illustrated in one of the IDRC-supported projects implemented at Andhra Pradesh Agricultural University. This project has been undertaken to evaluate and upgrade the utilization of dryland crops, particularly sorghum and millet. Market surveys were carried out on production, storage, processing, and consumption trends of sorghum and millet. Results clearly indicated that the inadequate processing and preparation methods of these grains are key factors limiting consumption. Because no suitable foods for infants and young children could be prepared with unprocessed grain, introduction of supplementing food was often delayed, resulting in a high incidence of malnutrition. Introduction of mini dehullers for processing sorghum and millets facilitated the development of a wide range of sorghum products of high status value which are widely acceptable. Biscuits made with dehulled sorghum flour (replacing refined wheat flour by 100%) proved to be a highly acceptable food for children in rural and urban areas. A rural bakery based on sorghum and millet as raw materials in a test market study proved to be very successful. Urban market studies indicated the scope for replacing rice or wheat by sorghum in many of the homemade products as well as commercially marketed foods especially in baked products.

The study indicated that introduction of appropriate mechanical dehullers will provide multiple benefits for the rural poor, which include: (a) improvement of nutritional status of women and children, (b) generation of employment and income, and (c) expansion of market demand for sorghum and millet.

Based on these results which are highly encouraging it is proposed to study in the next phase of the project (a) the possibility of developing small enterprises operated by women as a means of creating additional income, which is expected to improve nutritional status of women and children; (b) introduction of sorghum and millet foods in government supplementary feeding programs to reduce the cost and promote utilization of sorghum; and (c) promotion of sorghum weaning foods in urban and rural markets.

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Market Needs for Vegetable Drying in Sri Lanka

Consumer acceptance surveys were carried out using samples of the solar dried vegetables ash plaintain (*Musa sapientum*), bittergourd (*Mormodica charantia*) and drumstick (*Moringa oleifera*). The first survey was carried out in Colombo using 65 households with samples of sliced-cut vegetables solar dried in Colombo. The second and third surveys were carried out in the Kandy and Colombo districts, respectively, using solar-dried products manufactured by rural families in the dry zone village of Waguruwela under the instruction of our project officers.

The results of the first survey indicated a good response by consumers from all income groups. Ash plantain chips for frying and cooking had good acceptability. Drumstick pulp was preferred to drumstick pieces and bittergourd slices were rated well. A few problems in texture, flour, and reconstitution of the products were highlighted and need to be investigated and corrected by further developmental work.

Fruits and vegetables in Sri Lanka are processed into a variety of products including fruit juices, cordials and squashes, jams and jellies, preserves and candied fruit, canned fruit, chutneys, sauces, and pickles. Raw materials mainly include passion fruit, pineapple, mango, tomato, lime, woodapple, pumpkin, and, to a small extent, papaya, guava, jackfruit, belli fruit, ambarella, and strawberry. Production is carried out in small-, medium-, and large-scale processing industries where high management standards and quality control are maintained to manufacture products for an extremely competitive local and export market.

There is, however, a much wider range of tropical fruits and vegetables that are traditionally cooked and consumed by the local populace but are not processed or preserved as industrial products. These are produced in abundant quantities but are grossly underutilized because of inadequate marketing and distribution channels.

The highly perishable excess produce often spoils in the field, and farmers are compelled to sell at very low prices. In contrast, at the wholesale markets of Colombo and the major cities, the same produce fetches 200 – 300% the price set at the production site. This is primarily because of the extremely high prices demanded by traders and transporters who deliberately exploit this situation. In the off season, these problems are even more pronounced.

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There is a great need to introduce methods for preserving and extending the shelf life of these fruits and vegetables to minimize waste and increase availability throughout the country. Dehydration and, particularly, solar drying offer a simple, efficient, and low-cost method for preservation, especially in the dry-zone areas where plenty of sunshine and adequate land is freely available. Solar drying of vegetables is being carried out in many countries including the drying of jews mallow and okra in Egypt, green leafy vegetables in Kenya, and onions in Nigeria (Yaciuk 1982). The Ceylon Institute of Scientific and Industrial Research has developed processes for the solar drying of many dry-zone vegetables including ash plantain (*Musa sapientum*), drumstick (*Moringa oleifera*), okra (*Abelmoschus hibiscus*), brinjal (*Solanum melongena*), bittergourd (*Mormodica charantia*), bread fruit (*Artocarpus communis*), jackfruit (*Artocarpus heterophyllus*), yams, and selected leaves.

In a rural project in the dry-zone village of Waguruwela in southern Sri Lanka our project officers are teaching rural families to manufacture good-quality solar-dried vegetables that are easily reconstituted. Traditional sun drying of vegetables is a common practice in these areas, but because of discolouration and poor shelf life they have not found acceptance in the urban markets. Solar-drying techniques that employ improved processing methods result in better-quality products that open up potential new markets both in Sri Lanka and abroad. Because dehydrated fruits and vegetables are unfamilar products in our local markets, the Sri Lankan housewife needs to be persuaded into using these products in her normal cooking perparations instead of using fresh produce.

A consumer survey was carried out to assess the potential for introducing solar-dried vegetables to consumer households and to evaluate their future market. As a substitute for the fresh product, it was also necessary to identify any problems in consumer acceptability and organoleptic qualities for which appropriate remedial measures would have to be taken. This project highlighted cases where solar dried products manufactured in the rural areas were now being used by housewives in urban areas.

Fruit and Vegetable Cultivation in the Dry Zone

Fruit and vegetable cultivation in the dry zone of Sri Lanka is highly seasonal, depending mainly on the rainy period. There are two distinct production seasons: the Maha following the rains in October and the Yala following the rains in May. Crop cultivation is limited during the extreme drought that stretches from June to September. Cultivation statistics (Table 1) show that many hectares of banana, ash plantain, jackfruit, chillies, limes, papaya, oranges, and pumpkin are under cultivation during the two seasons. These figures, however, are unrealistically low because little information is available on cultivation statistics in many distant rural villages.

Methodology

Raw Materials

The Sri Lankan consumer is not used to utilizing dehydrated fruits and vegetables, so it was essential to plan the strategy for their introduction carefully. Fresh vegetables in Sri Lanka are mainly used in curries, if the housewife

Table 1. Extent of cultivation of fruits and vegetables in the dry zone (hectares).

Fruits and vegetables	Botanical name	1980	1981	1982	1983	1984
Ash plantain	*Musa sapientum*	14569	16800	18390	18340	18800
Bittergourd	*Mormodica charantia*	1424	3100	3220	3260	3340
Bread fruit	*Artocarpus communis*	2523	4980	5000	4980	4890
Brinjal	*Solanum melongena*	6200	11860	10080	9880	9550
Cucumber	*Cucumis salivus*	938	2450	2060	2180	2320
Jackfruit	*Artocarpus heterophyllus*	10099	17190	17180	17700	16750
Lime	*Citrus aurantifolia*	7422	3910	3880	3700	3950
Mango	*Mangifera indica*	11405	8130	8080	8360	9580
Okra	*Abelmoschus hibiscus*	6292	7990	7400	7510	7670
Orange	*Citrus aurantium*	5452	3350	3250	3090	2870
Papaya	*Carica papaya*	3273	2720	3010	2950	3010
Plantain	*Musa paradisica*	29175	29600	30310	30850	35880
Pumpkin (ash)	*Benincasa hispida*	1068	1250	1240	1160	1420
Pumpkin (red)	*Cucurbita maxima*	5620	8470	7580	7370	8810
Snake gourd	*Trichosanthes anguina*	1602	3390	3420	3480	3150
Tomato	*Lycopersicon esculentum*	2674	5170	4250	4360	3920

Source: Department of Statistics, Agricultural Information Division.

however, is provided with a substitute raw material, which can be soaked in water and easily reconstituted, this would help to enhance its attractiveness. Solar-dried ash plantain, jackfruit, bread fruit, bittergourd, and drumstick cut into slices or uniform pieces rehydrated satisfactorily and produced acceptable curries when cooked. Brinjal and okra underwent distinct colour and texture changes when dried. Fruits such as mango, papaya, orange, tomato, pumpkin, and guava could be dried as pieces or as pulp. Again, there were some changes in colour and texture and more developmental work is needed to improve their quality for the market. These products could be considered separately as a new category of ready-to-eat convenience foods for a future market study.

Another aspect considered in selecting raw materials was the multiplicity of methods available for the home use of each vegetable. Ash plantain can be cooked in two different preparations and as a fried chip with good potential for a snack-food industry. Bittergourd can be used as a cooked curry, a fried product, and was popular for its medicinal properties as an antidiabetic. The third vegetable selected on this basis was drumstick as it is a very popular vegetable valued for its distinct taste and flavour. It can be cooked as a curry in two preparations and its fruit pulp separated and used as a tasty vegetable filling. Bread fruit and jak fruit can also be used as chips and for cooking as a curry/sambol. It was decided initially to restrict this study to the three vegetables — ash plantain, drumstick, and bittergourd being the more popular items.

Solar Drying Processes

The processes used for solar drying are given in Fig. 1. Fresh, whole, blanched material was sliced or cut into appropriate pieces, pretreated accordingly, and dried in a conventional box-type solar drier with direct heating by sunlight (Fig. 2). Optimum product quality and rehydration characteristics were

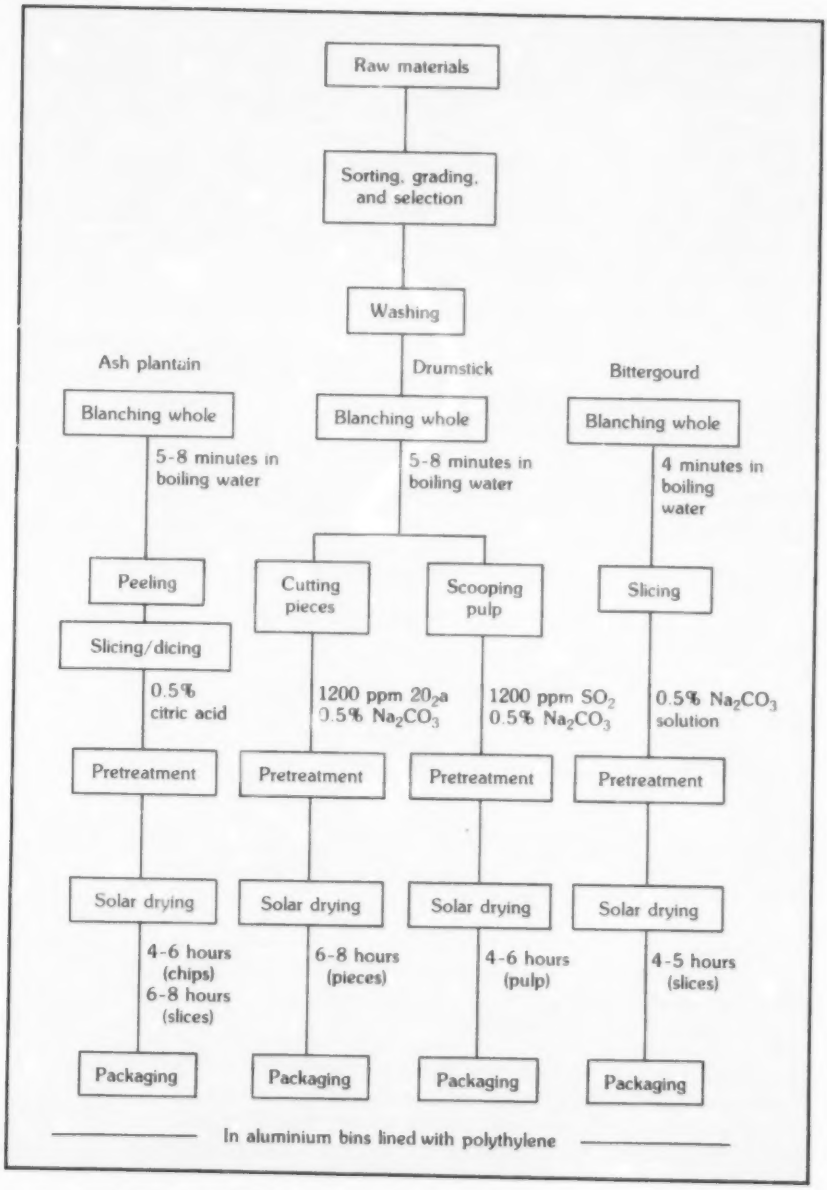

Fig. 1. Solar drying processes of ash plantain, bittergourd, and drumstick. (Note: use of SO_2 is avoided in the field because misuse of the chemical could cause problems.)

observed in products dried to a final moisture content of 6–8%. The products were packed in airtight aluminium bins lined with polyethylene. Packing with inert gas would be preferable.

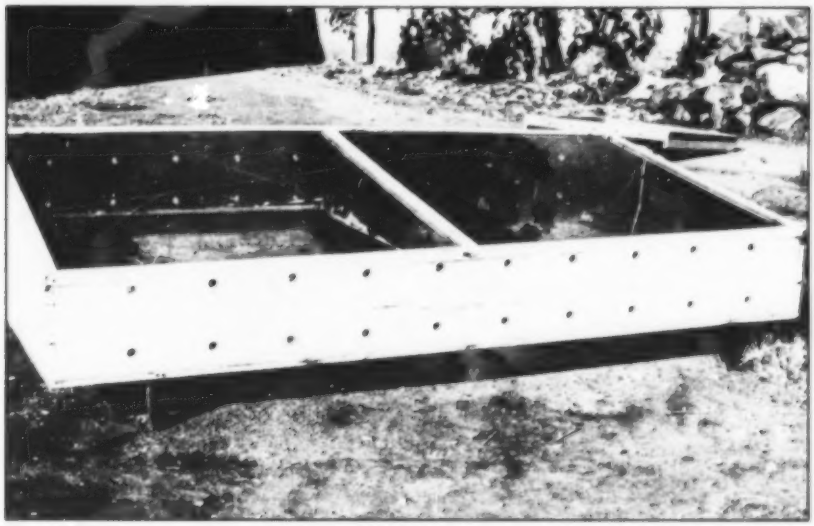

Fig. 2. Solar drier used at the Ceylon Institute of Scientific and Industrial Research (CISIR)

Consumer Market Survey

The consumer market survey to evaluate the potential for the selected dehydrated vegetables was planned in two phases: Phase I — preliminary survey in Colombo, 65 selected households, using products manufactured at the CISIR in Colombo; and Phase II — two surveys in (a) Kandy (a hill-country city where these vegetables are not freely available among 30 households) and (b) Colombo, a second survey using products manufactured in the dry-zone village of Waguruwela in the Hambantota district.

Consumers were selected from different regions of the Colombo and Kandy districts. Preference was given to families with children. It was also ensured that there was sufficient representation of the different socioeconomic groups and races in the households selected.

Consumers were visited and the required information obtained using questionnaires and interviews. Questionnaires were pretested before use. Three visits were made to each household at 2-week intervals. Samples of the product, attractively packaged in 100 g quantities with the appropriate questionnaires, were given to each housewife with a small gift as an incentive for their assistance.

At the time of writing this report, the first consumer survey has been completed in Colombo and the second and third surveys are in progress in the Colombo and Kandy districts, respectively. Results obtained so far will be briefly outlined and our future expectations of this study will be discussed. At the end of the study, as a token of appreciation, a small packet of sweets was left behind for the children of the household.

Consumer Backgrounds and Habits

Consumer behaviour is often influenced by economic, social, and psychological aspects (Proctor and Stone 1982) and many variables need to be determined as a background to evaluating the consumer acceptability of a product. Information was first sought on selected variables related to the background of the consumers under study. This was done by interviewing the housewife using a questionnaire. The variables considered included the following:

(a) Income group — Upper income > LKR 3000/month (USD 120), Middle income LKR 1000–3000/month (USD 40–120), Lower income LKR 1000/month (< USD 40)

(b) Family composition — Adults 25 years old, grown children 15–25 years old, and young children 15 years old.

(c) Nationality — Sinhala, Tamil, Muslim.

(d) Housewife — Occupation — employed or unemployed.

(e) Residential location (zones) — Colombo zone 4 or 7; Colombo zones 4, 5 or 6; outskirts (Dehiwela, Mt. Lavinia, and Moratuwa); suburbs (Talawatugoda); and Colombo zones 8 or 10.

(f) Dietary preferences — Vegetarian and nonvegetarian.

(g) Purchasing pattern of vegetables — Frequency of purchase, quantities purchased, and off-season purchase.

(h) Social activities — Visits to cinemas, fairs, carnivals, sports events, parks, etc., to evaluate potential for chip snack foods.

(i) Preferences for the selected vegetables ash plantain, bittergourd, and drumstick.

Acceptability of the Products

The products distributed included dehydrated ash plantain slices (thin for chips and thick for curry), drumstick pieces and pulp for cooking, and bittergourd slices for cooking or fried for use in a salad (Fig. 3). Consumer reaction was evaluated using two questionnaires followed by personal interviews to obtain more details. Consumer acceptability was assessed in terms of overall reaction to the product, taste and flavour, colour, and texture. The response was rated in terms of a hedonic scale (very good, good, fair, unsatisfactory, poor). The reactions of each of the household members according to different age categories (housewife, other adults, grown children, and young children) were also rated.

Final Assessment of Consumer Reaction

Consumers were asked a few questions to assess their overall reaction to dehydrated products.

(a) Whether they would prefer to buy dehydrated products to fresh raw material if available at half the cost.

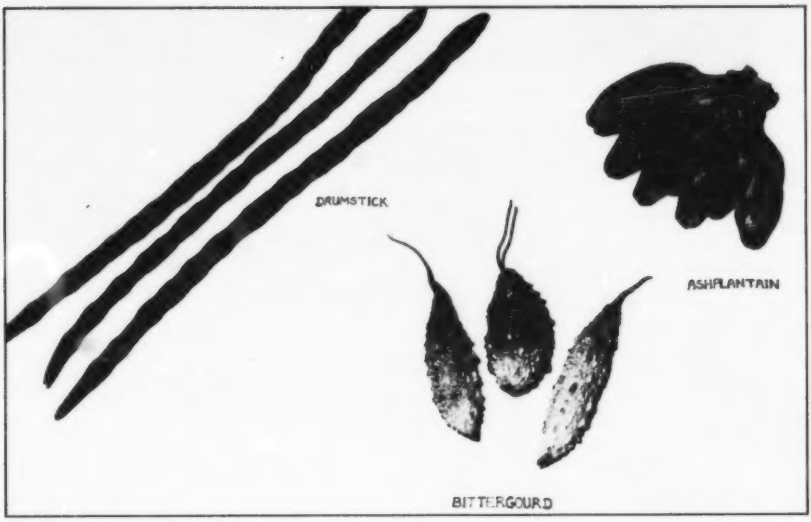

Fig. 3. Samples of the vegetables used for solar drying.

(b) The reasons why they may find solar dried products useful among the following: family likes it, can be stocked, overall a good product, easy to prepare, nice colour, it is tasty, and can be consumed as and when required.

Results

The households selected in all three surveys included about 30% of the homes in each of the three income groups: upper, middle, and lower (Table 2). It was also ensured that there was a reasonable representation of adults and grown and young children in all the surveys.

The wide distribution of households in different parts of Colombo and Kandy helped to maintain the representativeness of the study and reduced the possible bias in attitudes. The majority of the households visited were of the Sinhala community, although a few Tamil and Muslim households were also included. Both employed and unemployed housewives were interviewed. It was also found that almost all households ate a nonvegetarian diet, totally vegetarian households were difficult to locate.

The majority of households in the upper- and middle-income groups owned their own refrigerators and could purchase vegetables once or twice during the week and store their produce. The majority of the low-income groups had to make their purchases at 2–3 day intervals.

Quantities of vegetables purchased were in the range of 250–500 g per vegetable by majority of the households and 1 kg quantities by some others. This is related to the size of the household but serves as a useful index in deciding on the quantities for packing the dehydrated vegetables for the future market. It was also

Table 2. Distribution of consumer households (%) by income groups and age categories.[a]

	Upper income			Middle income			Lower income		
	I	II	III	I	II	III	I	II	III
Total number of households (%)	29	40	34	32	31	35	38	29	31
Households with									
Adults	29	40	34	32	31	35	38	29	31
Grown children	25	39	34	30	44	34	45	17	32
Young children	33	42	34	33	26	34	33	32	32

[a] Roman numerals I, II, and III, refer to the three surveys, respectively.

found that the majority of the households did not purchase seasonal vegetables during the off seasons. Those who did were mainly among the upper-income group in all the surveys. This indicated that dehydrated vegetables may have a good market in the off season.

Regarding the popularity of the three selected vegetables, ash plantain, bittergourd, and drumstick were popular among the majority of adults and grown children in all the income groups. Bittergourd particularly was much desired by persons suffering from diabetes. Among young children, ash plantain and drumstick were very popular but bittergourd was not as popular because of its bitter flavour. For ease of preparation, most consumers preferred ash plantain and drumstick in curry, whereas bittergourd was preferred as a fried salad. All three vegetables were habitually consumed at least once a week by most households during the season and the average quantity consumed was 500 g/week.

Ash plantain chips, although consumed by some, had not earlier been thought of as a snack food with market potential on a commercial basis (Fig. 4). Social habits of consumers, however, showed that the majority of families in the

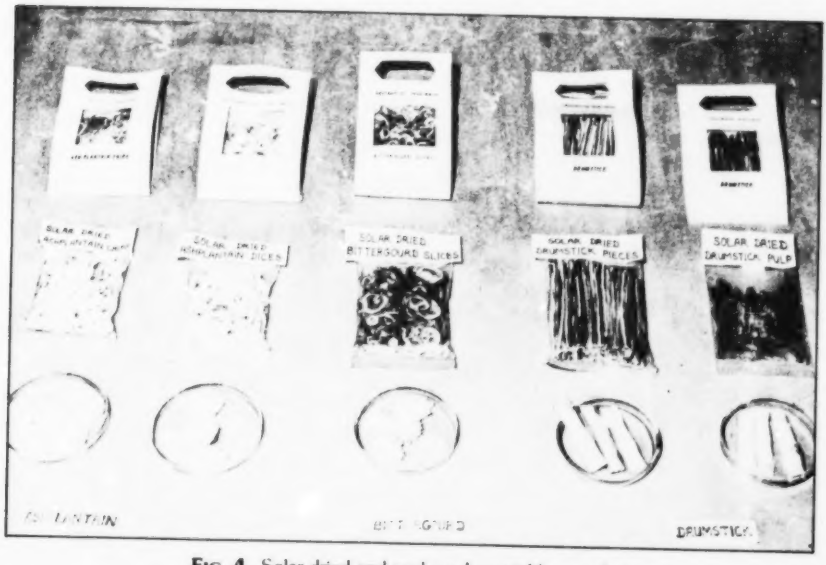

Fig. 4. Solar dried and packaged vegetable samples.

upper- and middle-income groups visited cinemas, carnivals, parks, and sports events where this sort of product could be marketed. The lower-income groups also visited these places but to a lesser extent.

Consumer Reaction to Ash Plantain Products

Ash plantain chips were well received by the majority of households in all three surveys conducted, showing that chips prepared in Colombo and in the dry zone had been of acceptable quality (Table 3). In quantitative terms the chips had been found generally acceptable and rated very good, good, or fair by over 90% of consumers in all three surveys, however, the product ratings in the first survey with products manufactured in Colombo were higher than the ratings given to the dry zone products. There didn't appear to be too much distinction between the ratings given by the different age groups but in all surveys it was apparent that consumers in the lower- and middle-income groups showed greater acceptability than the upper-income group. This was explained as the latter could afford a wider variety of foods and were more selective in their tastes.

The specific quality factors, colour, taste and flavour and texture were rated well by the majority of consumers, but Colombo consumers detected the difference of quality in the dry zone product, and the ratings were lower than the standard products. There appeared to be some variation in crispness of product texture among the chips manufactured from the same batch of raw material in many instances. This may be caused by factors in the fresh ash plantain such as variety and maturity at processing. This needs to be studied further.

The final acceptability of the chip by consumers in all three surveys showed that it was thought a good idea for marketing as a snack food. Consumer comments provided suggestions for popularizing the product such as flavouring with salt and chilli powder, packeting in a ready-to-eat form, ideas for convenient packing quantities (100 g, 250 g, and 500 g), suggestions for advertising and market promotion and many comments of appreciation of the product were given.

Ash plantain slices were also fairly well received in all three surveys but to a slightly lesser extent than the chips. The Colombo manufactured products were found generally acceptable by approximately 95% of households and the dry zone product by 85% of households. Adult consumers showed a slightly higher preference for the product than the children and here too the lower-income group consumers gave the higher ratings. The colour, taste and flavour, and texture of the products manufactured in Colombo were rated highly, although in a few instances there were complaints of an unnatural flavour and a slight pink colour. The dry zone product was better received by consumers in the Kandy district than in the Colombo district but these products were slightly off colour in contrast to the white products manufactured in Colombo. The colour and texture of the dry zone products were slightly lower than the Colombo product and a different taste and flavour remarked on as the "sun taste" was also noted by some consumers.

Final assessment of consumer acceptability showed that over 70% of the housewives from all income groups indicated that they would be interested in buying dehydrated ash plantain products if made freely available in the market. It could be thus confirmed that dehydrated ash plantain products could find a good market in Sri Lanka and could also be commercially exploited for a snack food industry.

TABLE 3. Consumer reaction to ash plantain (slices and chips) by different age categories.[a]

	Percentage rating of product quality											
	General quality			Colour			Taste and flavour			Texture		
	I	II	III	I	II	III	I	II	III	I	II	III
Plantain chips												
Adults												
Very good and good	83	89	76	78	91	65	74	80	63	81	86	65
Fair	17	11	20	22	6	32	24	20	31	16	14	29
Unsatisfactory and poor	0	0	4	0	3	3	2	0	6	3	0	6
Grown children												
Very good and good	91	72	77	87	84	70	80	78	66	26	78	70
Fair	9	28	14	13	11	28	20	22	35	72	22	24
Unsatisfactory and poor	0	0	9	0	5	2	0	0	9	2	0	6
Young children												
Very good and good	84	81	75	74	87	65	68	81	54	70	78	60
Fair	16	16	19	26	10	30	30	16	32	25	19	30
Unsatisfactory and poor	0	3	6	0	3	5	2	3	14	5	3	10
Plantain slices												
Adults												
Very good and good	79	74	63	80	77	58	80	71	78	85	77	46
Fair	18	23	28	18	20	36	17	26	19	13	20	43
Unsatisfactory and poor	3	3	9	2	3	6	3	3	3	2	3	11
Grown children												
Very good and good	75	61	65	77	78	63	77	66	80	82	61	40
Fair	16	39	28	16	17	30	14	28	16	16	39	43
Unsatisfactory and poor	9	0	7	7	5	7	9	6	4	2	0	17
Young children												
Very good and good	71	61	54	74	77	54	74	68	78	80	74	39
Fair	20	26	30	20	16	41	19	16	16	19	19	50
Unsatisfactory and poor	9	13	16	6	7	5	7	16	6	1	7	11

[a] I = Colombo survey with products manufactured in Colombo, II = Kandy survey with products manufactured in the dry zone, and III = Colombo survey with products manufactured in the dry zone, respectively.
(Strips for tables 3, 4, 5)

Consumer Reaction to Dehydrated Drumstick Products

Consumer reaction to drumstick pieces (Table 4) manufactured in Colombo was fairly satisfactory and over 75% of households rated the product acceptable, whereas only 52% of the households found the dry zone food acceptable. There didn't appear to be differences between the opinions of the different age categories. Income groups showed similar acceptability for the Colombo product but the dry zone product was only acceptable to the low-income category. However, drumstick pieces were rated lower than the ratings given for the ash plantain product. The texture and taste and flavour of the drumstick pieces were more preferred to the colour, which was a pale brown after drying. The dry zone product was found to be very dark and the colour was water soluble and removed on rehydration. It, therefore, did not discolour the food preparation made from it. This darkening of colour is absent in the hot air dried products and was attributed to effects caused by direct sunlight. Here too there was some variation in texture and reconstitution properties among samples from the same batch of raw material, which may be caused by differences in varieties and maturity of the fresh material or both. It was interesting to note that a few households preferred the "sun taste."

Evaluation of drumstick pulp showed a more favourable response in both the Colombo and dry zone manufactured products. Its acceptability was a little lower than ash plantain products but a great improvement to the acceptability of the drumstick pieces. It seemed that drumstick pulp when separated from the skin yielded a better dried product with a more natural flavour and improved reconstitution properties.

Dehydrated drumstick pulp manufactured in Colombo was found generally acceptable by over 90% of households, whereas the dry zone product was accepted by 69% of households. Greater preference was shown by adults and children in households of the lower-income group. Assessment of the special quality attributes showed a slightly greater acceptability of the colour and taste and flavour over the texture. General consumer opinion showed that, although the product was judged fairly acceptable, there was room for improvement in the taste and flavour and texture. As mentioned before, there is a need for better control of heat during drying in the dry zone to improve product quality.

Final assessment of drumstick products showed that only 30–40% of the housewives indicated interest in purchasing these drumstick products if made available freely in the market and the majority of these women were from the middle- and low-income groups. Consumer comments too indicated that all quality attributes (colour, taste and flavour, and texture) need improvement. However, its convenience and possible availability in the long off-season periods stimulated consumers' interest in this product. The quality of drumstick products, however, needs to be improved considerably to find a bigger market. More basic studies need to be done on both raw material and control of drying conditions.

Consumer Reaction to Bittergourd Products

Dehydrated bittergourd slices prepared in Colombo were distributed to consumers in the Colombo and Kandy districts. Consumer reaction was evaluated in dehydrated deep fried product made into a salad.

Table 4. Consumer reaction to drumstick (pieces and pulp) products by different age categories.[a]

	Percentage rating of product quality											
	General quality			Colour			Taste and flavour			Texture		
	I	II	III	I	II	III	I	II	III	I	II	III
Drumstick pieces												
Adults												
Very good and good	34	39	33	39	37	85	41	29	31	48	29	15
Fair	45	26	36	45	37	47	37	37	36	20	37	45
Unsatisfactory and poor	21	42	31	16	26	25	22	34	33	32	34	40
Grown children												
Very good and good	35	28	42	39	39	33	42	39	39	50	34	20
Fair	34	28	30	42	39	44	28	11	37	18	33	43
Unsatisfactory and poor	31	44	28	19	22	23	30	50	24	32	33	37
Young children												
Very good and good	36	29	26	40	39	24	42	32	32	45	23	8
Fair	45	23	37	47	32	53	38	52	60	32	35	52
Unsatisfactory and poor	19	48	37	13	29	23	20	16	8	23	42	40
Drumstick pulp												
Adults												
Very good and good	71	52	39	65	40	46	62	43	44	58	43	24
Fair	24	20	48	31	40	40	34	31	45	23	40	54
Unsatisfactory and poor	5	28	13	4	20	14	4	26	11	19	17	22
Grown children												
Very good and good	71	61	46	63	44	46	66	50	47	63	44	25
Fair	22	11	42	29	28	40	29	16	44	9	33	43
Unsatisfactory and poor	7	28	12	8	28	14	5	34	9	28	23	32
Young children												
Very good and good	64	45	37	58	39	42	58	41	42	55	45	24
Fair	29	19	50	34	32	40	34	26	47	26	26	40
Unsatisfactory and poor	8	36	37	8	29	18	8	33	11	19	29	36

[a] I = Colombo survey with products manufactured in Colombo, II = Kandy survey with products manufactured in the dry zone, and III = Colombo survey with products manufactured in the dry zone, respectively

Bittergourd slices were very well received by the majority of consumers both in the Colombo and Kandy districts (Table 5). Adults and grown children in over 90% of households found the product acceptable, whereas younger children showed a lesser preference due to the mildly bitter flavour. The colour, taste and flavour, and texture were found very acceptable by the majority of households in all income groups. It was very well received by most adults who valued it for its medicinal properties and nutritive quality.

Due to its unavailability in the dry zone during the field trials the products distributed were prepared in Colombo. However, few problems are envisaged in drying in the dry zone if the heat in the drier is suitably controlled.

Final Assessment of Products

When consumers were finally offered dehydrated products at half the cost of the fresh produce and asked their preference it was found that some consumer resistance was experienced (Tables 6 and 7). The majority of the consumers indicated that they would prefer the fresh produce but would buy some of the dehydrated products to reduce costs. This reaction is to be expected when a new product is introduced to the market. Traditionally, people in Sri Lanka have only consumed fresh vegetables and resistance to changing this habit is considered normal. Consumers also indicated that their interest in dehydrated products was mainly due to the fact that these could be stocked and used when required and also because they were easy to prepare. It is felt that with the manufacture of good quality products and sufficient advertising and market promotion this could develop into a useful industry in Sri Lanka.

Discussion

It was the aim of this study to try and convince housewives that dehydrated vegetables could be made available as substitutes for the fresh produce when required. Its convenience, ease of preparation and extended availability in storage was demonstrated. This study also demonstrated an example of utilizing rural processed products for marketing and distribution in the urban areas.

The results of the surveys showed that the ash plantain and bittergourd products would have a better market than drumstick products. The latter products manufactured in Colombo, however, had been found to have a satisfactory quality. Further studies in the varieties and maturity of the raw materials and the development of appropriate solar driers with better heat control was necessary for the industry in the dry zone. This would help to ensure good product quality during rural processing. Investigations were also shown to be necessary to determine the cause and minimization of the unnatural flavour referred to as the "sun taste" that developed in some of the products.

It was generally seen that the major market for these products would be among the low- and middle-income consumer households in Sri Lanka. It would especially serve as a useful source of supply during periods of scarcity. It was also established that dehydrated ash plantain chips could be used as a raw material for developing a new snack food industry in Sri Lanka.

TABLE 5. Consumer reaction to bittergourd slices by different age categories.[a]

	Percentage rating of product quality											
	General quality			Colour			Taste and flavour			Texture		
	I	II	III	I	II	III	I	II	III	I	II	III
Bittergourd slices												
Adults												
Very good and good	92	91	—	99	74	—	89	84	—	97	81	—
Fair	6	6	—	0	23	—	9	16	—	3	19	—
Unsatisfactory and poor	2	3	—	1	3	—	2	0	—	0	0	—
Grown children												
Very good and good	86	100	—	94	74	—	86	87	—	100	87	—
Fair	10	0	—	2	26	—	10	13	—	0	13	—
Unsatisfactory and poor	4	0	—	4	0	—	4	0	—	5	0	—
Young children												
Very good and good	81	64	—	92	68	—	81	60	—	83	64	—
Fair	11	18	—	2	18	—	11	22	—	10	36	—
Unsatisfactory and poor	8	18	—	6	14	—	8	18	—	7	6	—

[a] I = Colombo survey with products manufactured in Colombo, II = Kandy survey with products manufactured in the dry zone, and III = Colombo survey with products manufactured in the dry zone, respectively.

Table 6. Preference for fresh or dehydrated vegetables (at lower cost) by different income groups (percentage of households).[a]

	Upper income			Middle income			Lower income		
	I	II	III	I	II	III	I	II	III
Buy only fresh vegetables	9	—	19	3	—	22	2	—	5
Prefer fresh but would buy dehydrated to reduce cost	9	83	52	2	72	52	2	78	80
Would buy both equally	40	17	29	51	28	26	51	22	15
Would buy only dehydrated vegetables	42	—	—	44	—	—	45	—	—

[a] Roman numerals I, II, and III, refer to the three surveys, respectively.

Table 7. Questionnaire responses of households (%) concerning dehydrated products.

	Upper income			Middle income			Lower income		
	I	II	III	I	II	III	I	II	III
Family liked it	14	22	7	16	22	7	18	20	2
Can be stocked	18	26	37	18	26	28	18	33	10
Overall is a good product	10	4	2	12	3	8	11	5	15
Easy to prepare	25	4	30	24	7	25	21	14	17
Nice colour	5	26	—	4	19	2	5	14	6
It is tasty	15	7	5	13	13	5	23	—	35
Can be consumed in a variety of ways	13	11	19	13	10	25	4	14	15

An assessment of the economic feasibility of establishing a rural industry of this nature in the dry zone showed that if the rural farmers process their own produce in their own premises with the help of their families using low-cost solar driers this could prove to be a very feasible rural industry in Sri Lanka.

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Market Needs for Grain Drying in the Philippines

A two-level farm and mill survey was conducted to determine the constraints in the low adoption of mechanical dryers by the private sector. The surveys revealed that the major constraints among nonusers were (a) low production/low volume of procurement, (b) limited capital, and (c) unavailability of the dryer in the area.

Among previous users, the major constraints in the continuing use of the dryers were (a) high fuel cost, (b) lack of understanding about the mechanical drying technology resulting in poor quality of dried paddy and difficulty in operation, and (c) incompatibility of drying with the volume of paddy to be dried. Those who continued to use the dryers found (a) an increase in the volume of procurement during the wet season, (b) maintenance of paddy quality, and (c) a better price for good-quality milled rice.

To understand further the factors necessary for the viable use of mechanical dryers, an in-depth analysis of successful users of mechanical dryers was conducted. The case studies revealed that the successful use of dryers required large volumes of paddy, compatible dryer capacity with drying requirement, integration of the dryer as a support facility to a milling/marketing operation, and technical know-how in operating the dryer.

Other market factors affecting the decision to use mechanical dryers were also analyzed. The presence of a market for wet paddy, the lack of incentive to dry under the existing pricing structure, an inapplicable grading system, and the existence of a market for low-quality milled rice all contributed to the private sector's reluctance to dry their produce mechanically.

The introduction of an irrigation system, high-yielding varieties, and improved farming practices have resulted in increased grain production in the Philippines. Along with the increased production, however, is the increased quantity of deteriorated grain because of improper postharvest handling of the grain. There are remarkable qualitative and quantitative grain losses arising from the inability to dry high-moisture grain during periods of unfavourable weather.

Immediate and proper drying of newly harvested grain is an important postharvest practice in maintaining the quality of the grain. Mendoza (1984) revealed that a delay in threshing and drying behond 42 days from piling and 10

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days during storage, respectively, can trigger fast deterioration. Grain subjected to a delay in drying for 14 days increased yellowing by 2–3%.

Poor-quality paddy produces poor-quality milled rice, which, consequently, has a lower value in the market, thus, buyers offer a lower farm-gate price for wet and damaged grain to the detriment of the producers.

Grain drying is, therefore, encouraged to enable the producers to enjoy the premium price for paddy. The inability to dry grain adequately and immediately, however, remained a problem, particularly during the wet-season harvest. Unfortunately, the main crop is ready during the wet season, and the consequent deterioration of the large volume of grain represents significant monetary and economic losses in the grain industry.

Mechanical drying using heated air seems to be the best alternative to the drying problem. Several types of mechanical dryers are available in the local market; the flatbed, recirculating, and continuous-flow dryers. These dryers have been adopted for local conditions, however, their rate of adoption is still low despite the vigorous drying campaign program of the government.

Mechanical Drying Program

Recognizing that mechanical drying is the only alternative method of drying wet paddy when sun drying is not possible, their use has been promoted by different government agencies concerned with the grain industry including the Ministry of Agriculture and Food (MAF), the Farm System Development Corporation (FSDC), the National Food Authority (NFA), and the National Irrigation Administration (NIA). Through these agencies, financial and technical assistance was provided to promote the dryers at the farm and mill levels. The millers were encouraged to use and invest in mechanical dryers by allowing them to expand their business, provided the implementation of a mechanical dryer is part of the expansion program.

Mechanical dryers were also promoted through individual farmers and farmers' associations by encouraging them to use the mechanical dryers rented out by the NFA. Records show that from 1974 to 1984 the NFA had bought 400 units of flatbed dryers in support of the Facility Assistance Program and distributed them throughout various rice-producing areas. Some government agencies were engaged in similar activities and bought mechanical dryers for demonstration purposes and sold them to the cooperators at cost. Specifically, the FSDC extended financial assistance to farmers' groups for investment on postharvest facilities including mechanical dryers.

In addition to its Facility Assistance Program, the NFA has also been giving incentive fees for good-quality dried paddy. A PHP 0.03 incentive is given for every kilogram ($7.60/t) of good-quality dried paddy purchased (as of 1986, 18.72 Philippine pesos [PHP] = 1 United States dollar [USD]).

Technical assistance in assembling and operating the 2-t capacity flatbed dryer was also provided by the NFA and by other agencies. They directly supervised the initial operation of the dryers by the farmer or trained the operator. Both the Technical and Facility Assistance Program of the NFA were promoted through their various postharvest seminars conducted at the farm and mill levels.

Constraints

Despite the vigorous campaigns of the government to use mechanical dryers at the farm and mill levels to minimize the grain-deterioration problem and improve the value of stocks, especially during wet season, the rate of investment/adoption of mechanical dryers at the private sector is still low.

Several studies on mechanical dryers have been conducted, but most of these studies focused on evaluating the technical performance of the dryers. Few have evaluated social acceptance and economic viability in the specific environment in which they were intended to function.

Some of these studies (Sison et al. 1983) evaluated the social acceptance of University of the Philippines at Los Baños (UPLB) designed machines including the flatbed dryer with 2-t capacity. The study revealed that the constraints to the wide adoption of the machines were more socioeconomic than technical. Analysis of the end-users' response showed that they were likely to accept and continue to use the machine if it proved to be more economical than the method they were presently using. The foremost constraints to the use of dryer were its high fuel cost, additional labour inputs required, slow rate of drying, and the poor quality of dried paddy.

Another related study by Alvair et al. (1981), which was not limited to dryers alone, showed that the high cost of fuel and oil was one of the constraints to the successful adoption of farm machinery. The high cost of repairs and maintenance to farm machinery because of frequent breakdowns was another factor. The consequent delays in its use also resulted in great opportunity losses, particularly during times of critical farming operations, which further discouraged the utilization of farm machinery.

The National Post Harvest Institute for Research and Extension (NAPHIRE) also conducted an in-depth socioeconomic study to understand further the factors contributing to the low adoption of mechanical dryers and to determine not only the root causes of these factors but also to evaluate what possible requirements are needed to overcome these factors.

Specifically, the objectives of the study were (a) to determine the socioeconomic constraints to the use of the mechanical dryers, (b) to determine the requirements for the successful use of the dryers, and (c) to establish the most feasible drying systems appropriate for typical levels of postharvest operation. To achieve this, a two-level survey at the farm and mill levels, case studies of existing users of mechanical dryers, and feasibility studies of mechanical dryers were conducted in sequence.

In the survey, the individual farmers, farmers' groups, and millers were taken as respondents. They were stratified into users and nonusers of the dryers. Users were further stratified into continued and stopped groups. The users were purposely taken, whereas the nonusers were taken at random in the same area. Names of users were taken from the list of registered farmers from the National Food Authority, others not in the list were provided by the initial interviewers.

Four existing users, two private millers and two farmers' associations were taken as cooperators in the case studies. Each cooperator was interviewed and their present management and operation practices were observed. The financial condition of each group was also analyzed.

Feasibility studies of integrating mechanical dryers into average large- and medium-scale rice mills as potential users of dryers were conducted. The capacities of these dryers were based on the drying requirement of each rice mill.

Results of the Study

Constraints

Mechanical Dryers

There were only a few users of mechanical dryers at the farm and mill levels. Of these, not all were satisfied with the performance of the dryers but their dissatisfaction was basically socioeconomic in nature. Other reasons were because of a lack of the necessary skills needed to operate the mechanical dryers.

Previous Users

The most important of these constraints as stated by previous users was the high fuel cost. Fuel accounted for a significant percentage of the total operating cost of a dryer. This was further aggravated by the fact that the rate of price increases for fuel was faster than the rate of increase of other inputs.

The poor quality of the mechanically dried paddy was another reason given by those who stopped using the dryers. Mechanically dried paddy, according to them, was dull in colour and brittle when milled. Thus, low-milling recovery and higher "broken" were observed. Viewed against the exhaustive technical performance tests conducted on dryers before their manufacture, the poor-quality of paddy may not be a result of technical features of the dryer but rather may be brought about by (a) improperly adjusted dryer components, (b) poor initial quality of paddy before drying, and (c) a general lack of knowledge about operating the dryer.

The inconvenience resulting from heat and dust encountered while mixing the paddy during drying also reflected a lack of skill in properly operating the dryer. The flat-bed dryers are designed to dry a static mass of grain, thus no need of mixing while drying.

Complaints about the limited capacity of the dryers indicated an improper selection of the appropriate dryer. The capacity of the dryer was not properly matched with the drying requirement, thus, a shortage of dryer capacity was experienced.

Some previous users felt that an investment on a mechanical dryer was not economical and was unprofitable considering that it was only used during the wet season. An actual cost/benefit analysis, however, was not performed by the users.

For the farmers' group, another important factor that restricted the use of mechanical dryers at farm level was the lack of a strongly organized farmers' group. The use of mechanical dryers in the farmers' group usually failed because of internal weaknesses and mismanagement.

Nonusers

Factors affecting the use of mechanical dryers among nonusers were also socioeconomic in nature and were either directly or indirectly experienced by nonusers. Some nonusers were just influenced by the negative experiences of previous users. Among the factors indirectly experienced by nonusers, limited

volume of production or procurement was the foremost constraint cited. Observations showed that farmer nonusers usually owned a small farm ranging from < 1 ha to 4 ha (i.e., 3 t/ha, 1 cavan = 50 kg). After harvest, most of the farmers' stocks were distributed under the following landlord's share: harvester/thresher, irrigation fee, and payment for production loan. The small amount left was mainly used for home consumption.

Miller nonusers were either small-scale millers or millers who intended to limit their procurement during wet season just to avoid the risk of grain deterioration because of their inability to dry the produce. Other millers could not use mechanical dryers because of their limited capital in view of the high investment cost of dryers. Farmers were also restrained from the use/investment of mechanical dryers by these limited resources. Both groups are not able to amortize or rent a unit of dryers because of the production and other postharvest expenses incurred.

In some cases, millers who were interested in using a dryer were unable to do so because of a limited space to accommodate a dryer. Instead, they sun dried using highways and other concrete pavements. Furthermore, it was noted that many farmer nonusers have not yet even seen a mechanical dryer. They remained contented with the traditional method of drying. This points to the low level of awareness concerning mechanical dryers among the targeted population of the drying problem during the wet season and the vigorous efforts by the government to promote dryers.

Benefits

Despite several constraints to the use of mechanical dryers, there were still users who intended to continue using dryers because of the benefits they derived from the equipment. Some of the benefits expressed by continued users were (a) prevention of grain deterioration; (b) opportunity to receive a better price; (c) opportunity to procure more stocks, dry more paddy for storage, and, hence, produce a larger business volume; and (d) less labour requirement/less spillage. In addition, farmers' associations cited the service extended to farmer members as another reason for their continued use of mechanical dryers.

Use Requirements

Case studies of existing users of mechanical dryers revealed that successful use required the following:

- A large volume of paddy to achieve economy of scale and a significant increase in profit to offset opportunity costs. If the volume of paddy to be dried is small, the cost of operation and the time and effort spent in drying may not be sufficiently compensated by the value of the stocks dried.
- The integration of a dryer operation as a support to existing milling and marketing operations to enhance benefits in terms of better-quality milled rice and increased business volume because of the ability to purchase stocks during the wet season. The direct benefits of mechanical drying are not easily perceived if the drying operation is seen and evaluated as an isolated activity. Drying needs to be viewed as part of the total system and the benefits assessed in terms of their impact on the other operations in the system.

- Proper selection of dryer capacity compatible with the volume of paddy to be dried to avoid any delays in drying and maximize dryer utilization. There were some cases where the capacity of the dryers was too big for the volume to be processed; thus, underutilization was experienced. On the other hand, if the capacity of the dryer was too small compared with the drying requirement, delays in drying were experienced.
- Sufficient technical knowledge in operating the dryer to maintain the good performance of the equipment to prevent any technical problems. Airflow rate and temperature should be properly adjusted to get optimum results in drying. The operator of the dryer should be properly trained before actual operation.

Market Factors Affecting the Decision to Dry

Aside from the socioeconomic constraints to the use of mechanical dryers that directly influence the farmers not to use the dryers, other important factors in the marketing system also affect their decision to use mechanical dryers or not.

Market for Wet Paddy

Paddy is directly sold to local traders, wholesalers, and millers either dried or wet. The farmers, however, often sell their paddy right after harvest, especially during the wet season because of their inability to dry the grain. Instead of risking the deterioration of the grain, they preferred to sell the wet paddy even if they had to do so at a low price. Also, their produce was usually committed before harvest to the traders who provided their production capital. Thus, the buyers usually set the price of wet paddy. Other millers who had the capability to dry grain, took the opportunity to buy more stocks during the wet season because the price of wet grain was relatively low compared to the dry-season price.

Lack of Incentive to Dry

Another important economic issue involved in the marketing system is the development of suitable incentives (Duff and Toquero 1975). Although the NFA provided an extra drying incentive of PHP 0.03/kg and a price differential for wet and dried paddy exists, these were not enough to compensate for the drying cost and time spent by the farmers, especially if only a small amount were dried.

Data obtained by NAPHIRE (Cardno 1984) revealed that the average price paid by private traders for dried paddy during the wet season was PHP 1.54/kg and for wet paddy (newly harvested) PHP 1.09/kg. Given that 5 kg was deducted for every cavan of wet paddy, the total value of wet grains was only PHP 49/cavan and assuming that dried paddy weighed 45 kg/cavan, its total value was PHP 69/cavan. Using the cost of drying obtained by NFA for flatbed dryers (Mangaoang 1984), i.e., PHP 220/t, the net profit received by farmers who dried their stock was PHP 58/cavan or PHP 9 higher than the income received by farmers who sold their stock wet (PHP 58–PHP 49).

In spite of the higher revenue obtained by drying the paddy before marketing, many farmers considered the benefits inadequate in light of the high risk and the opportunity cost involved in the drying process. Thus, they still preferred to sell their stocks wet. Furthermore, drying the stocks before selling would mean

delays in cashing the stocks, which is the farmers' main priority to meet his financial requirements.

Inapplicable Grading System

Grading standards set by the government are not followed in the local market because of their inapplicability under actual field conditions. Instead, a subjective grading system highly dependent upon the buyer's assessment, using sensory methods is adopted. The value of the grain was based on assessing the moisture level through sound produced by the grain when grasped, the colour of the grain, and the presence of impurities.

In the Philippines, two principal factors influencing the price are the variety and the visual appearance of the grain. The absence of a more systematic and objective grading system has discouraged the farmers from producing good-quality grain because the price does not reflect the true value of the grain.

Markets for Low-Quality Milled Rice

Consumers are not very discriminating in their demand for rice. A primary consideration in buying is the price. Thus, only a few are willing to pay a premium price for good-quality milled rice. These are mostly institutional buyers such as hotels and members of the upper middle and upper class of society. For the majority of the consumers, however, as long as the price is within their reach, factors such as broken rice, presence of stones and paddy, etc., are not given much weight. Consequently, low-quality milled rice is accepted in the local market.

To summarize, the poor economic conditions of farmers and millers and the unprofitability of using mechanical dryers in light of the small volume produced or processed stand as the foremost constraints to the wide adoption of mechanical dryers. The problem of profitability, however, could be overcome provided the necessary volume is processed, mechanical drying is integrated with other postharvest operations to enhance benefits, and the dryer capacity compatible with drying requirements is selected and the necessary technical knowledge is extended to the user. Furthermore, it is also important to consider the other external factors in the grain-marketing system that affect the use of mechanical dryers. Specifically, a favourable pricing scheme and a practical grading system need to be developed to encourage the production of a good-quality rice.

Recommendations

- Drying as a process must be studied and analyzed as part of the total marketing system. Cost/benefit evaluation of mechanical dryers done on a unit operation basis will not accurately reflect their advantages. The impact on the other postharvest operations and on the total system must be taken into consideration to assess accurately the benefits derived from mechanical drying. Thus, evaluation of dryer performance should include not only technical efficiency but also its effectiveness in meeting the requirements of the system.
- A practical grading system appropriate for farm-level use to provide a more rational basis for trading/marketing practices needs to be developed. Also, a supportive pricing scheme is needed that incorporates quality-grading

factors necessary to encourage the farmers to produce good-quality grain. The price differences of wet and dried grain should be commensurate with the cost and time spent in drying.

- Inasmuch as small individual farmers because of limited resources cannot afford to invest or use mechanical dryers, groups or associations could be used to perform mechanical drying at the farm level. Along with this, farmers' associations must be adequately trained and equipped to achieve strong management capability and efficient business operation.
- Extensive training and extension services to help the prospective users of mechanical dryers understand the principles involved in mechanical drying and make them aware of the benefits derived are also recommended. The improper use of mechanical dryers because of the lack of technical operating knowledge was reflected in the poor quality of dried paddy and other operational difficulties and inconveniences encountered during drying. Assistance in the selection of suitable dryers, e.g., type and capacity of dryer, should also be provided to avoid the problem of incompatibility of the drying capacity with the drying requirement.

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Product Information to Improve Small-Scale Food Manufacture in Thailand

A thorough knowledge of products in the market, raw materials, and processes is essential to carry out research and development effectively. This information is used to identify problems and key elements of the operation. Process improvement methodology is selected and applied where necessary to solve these problems and to improve existing processes in the small-scale food industry. Information such as production volume; location and site; grades and price of raw materials and products, respectively; trade channels; brands; composition; type of packaging used; marketing target; and competitive factories are being compiled and analyzed. The information will be used as a criterion in selecting the area to be improved and in screening certain techniques and methodologies for improving the process. Sampling of products in the market is carried out for taste panel evaluation and for comparing quality, including appearance, flavour, colour, and texture of existing products with the new improved product from the trial runs. The case study of process improvement for transparent noodles is given as an example.

The process-improvement project for the small-scale food industry in Thailand, initiated with the support of the International Development Research Centre (IDRC), has been carried out by the Thailand Institute of Scientific and Technological Research (TISTR) concentrating on the transparent noodle factory, which is one of the growing food industries in Thailand. Thai producers of transparent noodles can be classified into two major groups: large-scale producers for domestic and export markets and medium- to small-scale producers for domestic markets. Most of these producers, both large- and small-scale, are family run businesses and are secretive about their operations for fear of releasing information to competitors.

At present, there are about 23 factories producing noodles. These are located in the central and northern areas and there are two new large-scale factories being set up by two existing factories that are already larger than many others. Table 1 shows the range of initial registered capacity, capital investment, number of workers, and number of factories in each region. Cassava and mungbean and other beans are major agricultural commodities produced by Thailand providing an increasing amount of raw material supply for making transparent noodles. In 1983/84, the production of mungbeans was about 3×10^3 t (metric tonnes). Mostly they are for export, which accounts for about 50% of the total production. The remaining 50% is used for local consumption in which 54% of that figure goes

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Table 1. List of factories.

	Factories	Production capacity (t/year)	Capital investment (THB × (10^6)[a]	Workers
Central				
Bangkok	2	86–2340	0.1–10	22–402
Saraburi	6	30–650	0.01–1.9	3–53
Nakornpathom	3	30–50	1.1–1.5	11–80
Pathumthani	3[b]	>12	>1.69	>10
Nakornsawan	2	44–218	0.31–0.85	21
Kanchanaburi	1	26.4	0.05	19
Chachaengsao	1	105	4.5	25
Samutsakorn	1	3000	35.67	225
North				
Kamphaeng Phet	2	27–90	1.25–1.36	13–20
Sukothai	1	12	0.19	n.a.
Lampang	2	80–86.4	0.25–2.2	14–50
Chieng Mai	1	50	n.a.[c]	n.a.

Source: Modified from statistics produced by the Ministry of Industry.
[a] 26 Thailand baht (THB) = 1 United States dollar (USD).
[b] Two new large-scale factories are being set up.
[c] n.a. = not available.

into transparent noodle factories. The other 46% is for producing bean sprouts and dehulled half-beans (Fig. 1).

Reliable statistics for total production of transparent noodles are unavailable because there are only a few major factories but there are numerous small-scale factories scattered over the northern and central regions making data collection difficult. The total production of transparent noodles is estimated to be around 12 000 t/year with a growth rate ranging from 2 to 7% per year. The main production, however, only comes from two large-scale factories with about a 9000 t/year capacity in each factory, which accounts for about 76% of the total production in Thailand. Domestic demand ranges from 7800 to 9400 t/year.

In the past, Thailand imported transparent noodles from the major overseas producer, the Republic of China. Since 1947, Thailand started to learn how to make transparent noodles from the Chinese immigrant and production has gradually increased. As of 1985, Thailand has exported more than 300 t/year of transparent noodles to France, USA, West Germany, the Netherlands, Japan, Saudi Arabia, and Bahrain. The export quantity, however, is still low compared to China, the major world exporter of transparent noodles. It should be noted that China also imported more than 14 000 t/year of mungbeans from Thailand in addition to her own production, which is the highest in the world. Thus, there is a great demand for mungbeans. The objectives of this study are to improve the process of making transparent noodles in small-scale industries and to provide efficient utilization of indigenous raw materials.

Methodology

The research working group included multidisciplinary scientists, engineers, and economists who compiled all the possible information related to transparent noodle production to study the overall picture of this industry. Available literature on research and development is severely limited as is other production information because most of the processes have been developed through years of

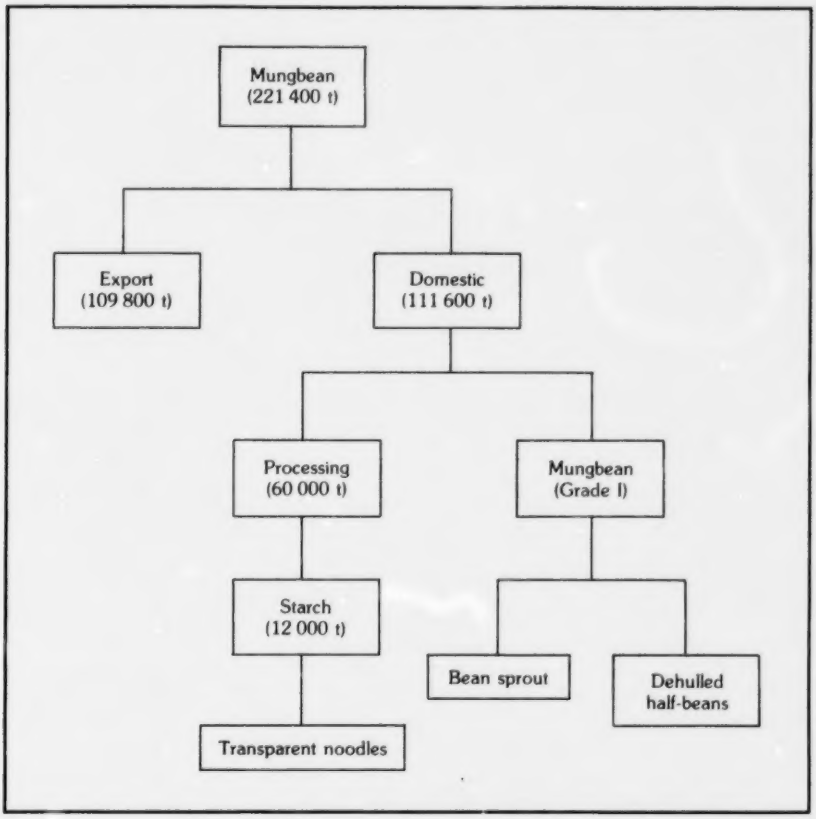

Fig. 1. Utilization of mungbean (1983-84).

experience and have been transferred in confidence through members of the family only. On-line computer searches have been conducted to find any related publications but this has met with limited success.

Therefore, several in-plant visits and surveys were conducted through personal contacts. The information was compiled and analyzed to produce details of the flow process chart, plant layout, equipment list, details of production, and other information on the industry. In addition, product surveys and samplings in the existing market have been conducted randomly.

Common problems in each factory have been classified as well as more specific problems requiring a thorough screening process, and the key operation leading to such problems is identified. The research team also contacted these small-scale factories to gain their agreement in conducting the process improvement studies. A research design is then set up and followed by additional data collection through several visits to the processing plant. The detailed data are then analyzed and interpreted.

Research and development studies were conducted to solve the key problem and to fulfil entrepreneurs' needs. In-plant trial runs were carried out with the

assistance of the factory owner followed by a technical and economic analysis before implementation. As a result, the methods developed to solve those problems are being transferred to these small-scale factories. (The process improvement methodology is summarized in Figs 2 and 3.)

Collection of Factual Information

As much information as possible is needed about the processes involved to provide researchers with the necessary background to solve existing problems. Examples of the type of fieldwork information and documentation required include:

- Raw materials: types and grades, quantity and seasons, price index, and trade channels.
- Product: composition, grades, price, brand and product line, packaging type and content, packing styles (consumer and institutional bulk pack), and marketing channels and sales.
- Factory: process flow chart, production pattern, yield and loss, types of equipment, energy consumption, and management.

Mungbeans are the basic raw material for grade A transparent noodles. Grades B, C, D, and lower grades are made from composite starch by mixing starch or flour such as imported potato starch, tapioca flour, and other bean starches with mungbean starch. These lower grades of transparent noodles are inferior compared to noodles from pure mungbean starch. It should be noted that transparent noodles must contain mungbean starch to have the required characteristics after cooking. These major characteristics are elasticity, stretchability, texture, clear and glossy appearance, bland taste, and normal flavour.

Mungbeans are grown primarily in the northern and central regions, but other types of beans, such as white beans, red gram beans, black beans, rice beans, and black gram beans, are also grown throughout the regions. The price index of various beans as shown in Fig. 4 covers a 12-month period (1980–81).

The major variety of mungbean grown in Thailand is called Uthong No.1. The beans are graded into four categories in which No. 1 and 2 are mainly for export and direct consumption, whereas No. 3 and 4 are mainly for making noodles and other purposes.

Figure 5 illustrates mungbean trade structure that includes: field middlemen (direct buy from growers), local middlemen (village level), regional middlemen (provincial level), local transparent noodle factories, brokers in Bangkok, and trading firms for export.

The grade A transparent noodle is made from mungbean starch only. Other grades are made from a mixture of mungbean starch and other bean starches with potato starch or tapioca flour or both. Producers pack these products in various brands according to grades and composition and these are sold in different price ranges as listed in Table 2.

The appearance and characteristics of transparent noodles also indicate grades of the products, especially the length of noodles with the largest being the better grade. The noodles, therefore, are classified as long, medium, short, clump,

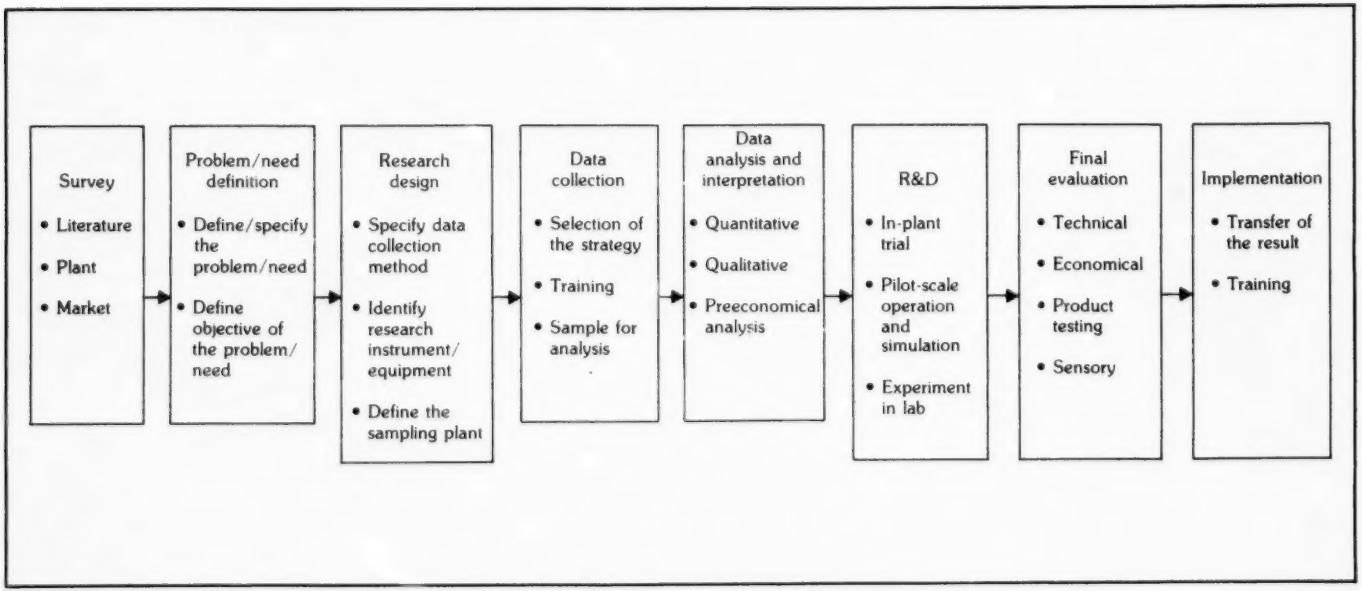

FIG. 2. Process improvement concept

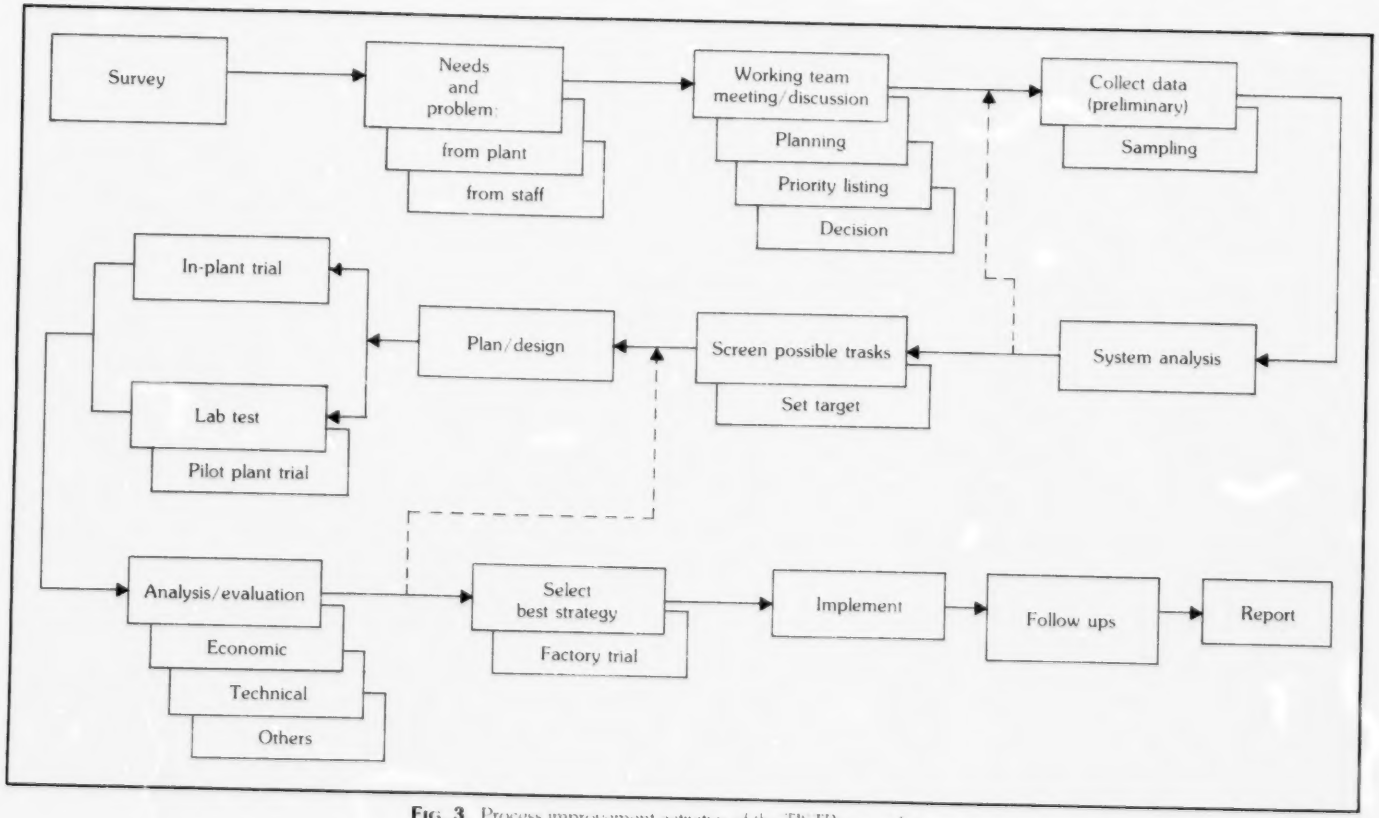

FIG. 3. Process improvement activities of the TISTR research team

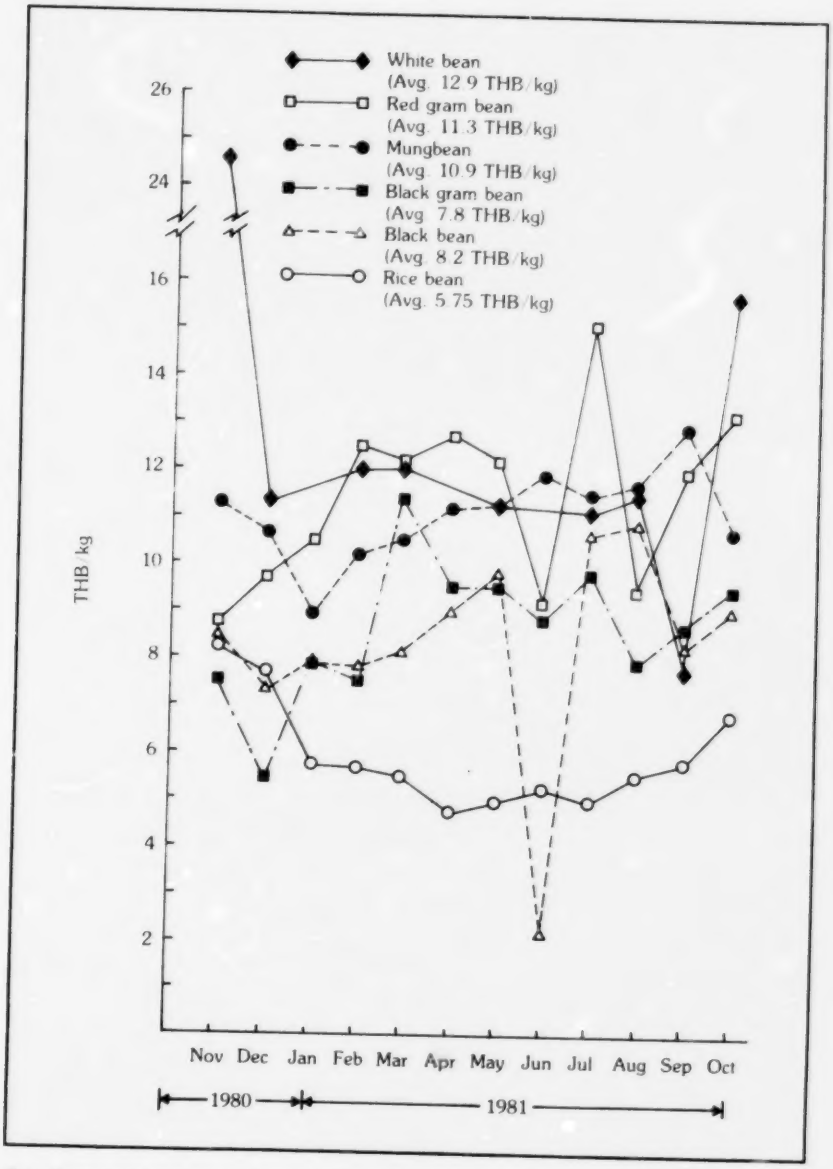

FIG. 4. Price index of various beans (source: adapted from the Division of Agricultural Economics, Ministry of Agriculture and the Ministry of Commerce). (26 Thailand baht [THB] = 1 United States dollar [USD].)

loose, or fragments. Other characteristics such as glossiness, opacity, degree of straightness, and thin round noodles are factors for grade determination as well as elasticity and adherent properties after cooking.

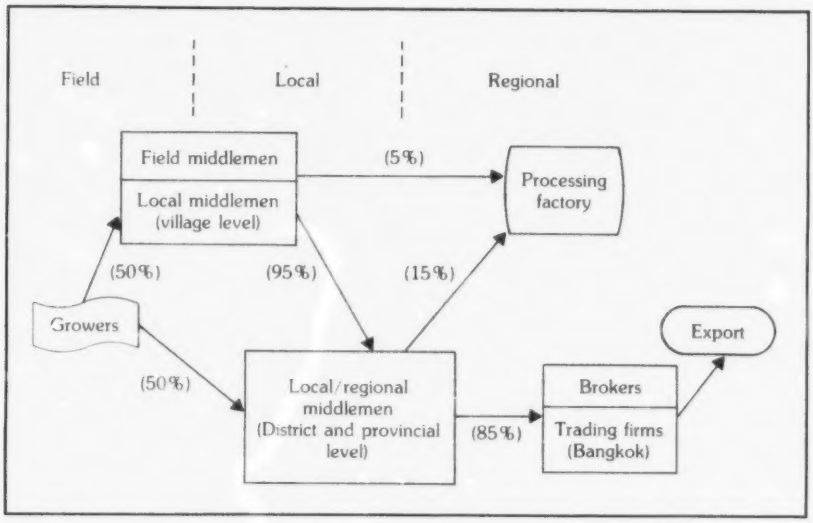

Fig. 5. Trade channel of mungbean.

Table 2. Product information.

Grade	Brand	Composition ratio			Price
		Mungbean[a]	Potato	Tapioca	(THB/kg)[b]
Special	Horse, Pagoda, Po tree, Lion, Pine Tree	100	0	0	58–74
A	Double Golden Fish, Mountain Tiger, Double Dragon, Peaches, Red Junk	100	0	0	48–58
B	Bamboo, Mungbean plant, AA, Golden Mountain, Double Fish, Angel, Elephant, Golden Peak, 999	80	10	0	38–49
		80	20		
		50	20	0	
		70	30	0	
		60	40	0	
		50	50	0	
		50	50	30	
		50	25	25	
C	Tiger, Fish, Peach, Monk	40	20	0	38–42
		30	30		
		30	60		
D	Bean Plant, Double tiger	30	30	30	32–36
		30	10	50	
		25	25	50	
		22	40	10	
E	(No brand)	20	40	0	17–30
		10	20	20	
		10	50	0	

[a] May be replaced by other bean starches or combination.
[b] 26 Thailand baht (THB) = 1 United States dollar (USD).

Table 3. TIS standard number 444 for vermicelli (transparent noodles).

Analysis	Criteria
Colour and odour	Acceptable
Size, in diameter (mm)	0.5–1.5
Broken (%)	< 3
Organoleptic test score (scale 5)	> 3
Moisture content (%)	< 15
Ash content (%)	< 0.3
Soluble in water after boiling for 10 minutes (%)	< 9
SO_2, mg/kg	< 45

In general, packing style, content, and types of packaging are similar among producers. These producers made their own brands and pack in bulk according to client orders. The bulk packs may be repacked and sold by the brokers or retailers under their own brands before distribution into the market. Two styles of packing commonly used are:

(a) Bulk pack — noodles are compressed in rectangular bundles by a screw press with a net weight of 10 kg/pack. This type of packing is used in restaurants, by street vendors, or it is repacked in smaller packs for retail sale.

(b) Consumer pack — noodles are packed into individual plastic bags and sealed with a net weight ranging from 30, 50, 100, 200, 500 g, to 1 kg. The packaging material used is mainly thin polypropylene (PP) for consumer packs and polyethylene (PE) for bulk packs.

Product Analysis and Sensory Evaluation

The Thai Institute Standards (TIS), Ministry of Industry, has issued a standard for transparent noodles No. TIS 444–1982, which is summarized in Table 3. Product analysis of various samples is conducted including organoleptic testing by determining the overall acceptance of the cooked product.

The TISTR working team on process improvement has conducted sensory evaluations that are designed to compare the improved product with the good-quality product in the market to check and follow up on the results of research work. The taste panel has been set up with the same five trained panelists who have participated regularly in every test. This test is very important to evaluate the improved product resulting from the research and development using the evaluation sheet as described in Table 4.

Summary

The information is used to guide the research team in conducting research and development leading to problem solving and to fulfill major needs of the food-processing industry. These data provide background information and aid in the understanding of the whole process.

From previous studies, the TISTR research team has carried out this process improvement project for the benefit of the local small-scale food industry and the

Table 4. Sensory evaluation sheet.

Description	Score
General characteristics	
Very elastic, stretchable, and do not adhere	4
Elastic, stretchable, and slightly stick together	3
Elastic, somewhat stretchable, and stick together	2
Not elastic and disintegrate easily or has a mushy texture	1
Appearance	
Clear and glossy	4
Clear but not glossy	3
Opaque and not glossy	2
Opaque, dull, and not glossy	1
Flavour	
Normal flavour, bland	4
Differs slightly from normal flavour but acceptable	3
Slight fermented flavour but still acceptable	2
Shows signs of fermented flavour, sour, sulfur flavour, or abnormal flavour	1

Evaluation:

Sample no.	Characteristics	Appearance	Flavour	Total score

Note: Scores of characteristics, appearance, and flavour after cooking must not be below 3.0 providing no score is given less than 1.0.

economic aspect of the country. Some of the benefits obtained by the factory owners were higher yield in the starch extraction process, energy savings in the freezing process, and minimal breakage of noodles during storage. Consumers were also satisfied with better-quality noodles. As a result, two factories that had been assisted by TISTR have expanded their processing facilities and doubled production capacity. The research team has tried to unwrap the traditional secrets and skills used by transforming a state-of-the-art into scientific and technological know-how to explain the noodle making process. At present, the research team has used the collected information to simulate the factory operation by producing quality noodles in the scaled-down pilot plant using up to 75% starch from other beans to replace mungbean starch. The team has even aimed at substituting mungbean starch completely for a certain type of market.

The benefit of using composite starch from other beans or tapioca starch is to reduce cost but with a minimal effect on noodle quality. Because the price of beans fluctuates according to the season, one can utilize other raw materials for least-cost production. On the other hand, farmers also can grow crops according to the processors' requirements.

In future work, the process improvement research team has plans for the modification of starch by utilizing inexpensive tapioca flour for the production of bean threads. The compiled information, such as market demand is, therefore, essential in providing criteria for researchers to understand fully the overall selection of certain techniques and methodology for improving the existing process.

Investigating the Marketing System for Groundnuts in the Philippines

The development of the groundnut (*Arachis hypogea* L.) industry in the Philippines has focused primarily on production activities. Limited work has been done in the field of postharvest technology, and much less in the area of marketing. Viewed as a whole, any improvements suggested for the groundnut industry must be the result of an integrated developmental approach involving various disciplines.

Marketing is an integral part in the development of the groundnut industry. In fact, the production benefits are useless if there is no appropriate and efficient marketing system for the product. In the Philippines, no groundnut-research study has used the team approach to market research except for the existing project funded by the International Development Research Centre (IDRC) entitled "Groundnut Industry Economics (Philippines)."

The case study presented in this paper highlights the experiences and approaches developed by the research team of the Isabela State University (ISU) and the National Post-Harvest Institute for Research and Extension (NAPHIRE).

Groundnut Industry Overview

Groundnut, or peanut, (*Arachis hypogea* L.), known in the Philippines as *mani*, is a very popular legume because of its versatility and economic importance. Commercially, the crop is grown for the snack-food market in the form of roasted and boiled groundnuts, groundnut butter and brittle, and other confectioneries.

Groundnuts are an important source of protein consisting of about 26–30% of dry-weight matter. As mentioned earlier, groundnuts are a popular snack food, and are consumed in a variety of forms. They can be boiled or roasted in the shell, roasted or fried in oil unshelled, and are used extensively in the preparation of baked goods and confectioneries. In terms of industrial utilization, peanut crude oil can be used in the manufacture of soaps and detergents. Peanut hay and meal are good sources of feed for livestock and poultry.

Groundnut production is widely scattered in the Philippines, although it is concentrated mostly in the Cagayan Valley region where, in 1981, it accounted for 47% of the total area planted. As one of the major sources of farmer income,

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groundnuts have contributed significantly to the national coffer. In fact, according to the Bureau of Agricultural Economics, in 1981, the total value of production amounted to 188.17 million pesos (in 1986, 18.72 Philippine pesos [PHP] = 1 United States dollar [USD]).

Production and Supply

The peanut supply of the Philippines comes from domestic production and imports. The area planted to groundnuts increased by 69% from 32 500 ha in 1971 to 54 900 ha in 1980. The increase in area planted to groundnut, coupled with the improvement in the national average yield from 580 kg/ha in 1971 to 908 kg/ha in 1980, increased production by 164% from 18 862 t (metric tonnes) in 1970 to 49 841 t in 1980.

From 1971 to 1980, although the import value of groundnuts fluctuated, statistics show that there was a general increase from 300 t in 1971 to 10 730 t in 1980. With the majority of the imported products being in the form of cake and meal for use as animal feed.

Domestic Prices

The increasing demand for groundnuts has steadily pushed the national average farmgate prices up from PHP 2.99/kg (unshelled) in 1976 to PHP 7.93/kg in 1985 for an increase of 165% over a period of 10 years. The average retail price for 1976 was PHP 3.68 and increased to PHP 8.83 in 1985 for a 140% increase over a period of 10 years. Price differential between retail and farmgate is estimated to be PHP 0.70 for the 1985 trading operation (based on preliminary reports from the IDRC/ISU-NAPHIRE groundnut research project).

Usually, a better price is offered for groundnuts with large pods containing 2–3 kernels/pod. Also, groundnuts command a higher price when sold during the lean months or when the supply starts to decline. Normally, the price increases when seed materials for groundnuts that are available during the main cropping season become scarce during the wet cropping season.

Marketing Channels and Structures

In general, there is no systematic marketing strategy for groundnuts in the Philippines. Before the commodity finally reaches the consumer, it must pass through various disorganized channels or outlets. The groundnut producers usually sell the unshelled produce directly or indirectly to agents, assemblers-wholesalers, retailers, wholesalers-retailers, processors, and final consumers at the farm, roadside, public markets or at the buyer's place of business. The final price of the product by the time it reached the consumer would necessarily be increased because of the number of intermediaries involved. (Fig. 1).

The trading operation for groundnuts is heaviest from March to May, which is the main harvest period. The most competitive trading is usually between institutional and noninstitutional traders.

Groundnut marketing in several municipalities of Isabela (the main province in groundnut production in the Cagayan Valley) indicated that the bulk of the produce was sold to assemblers-wholesalers who either set up their own buying centres or transacted business directly with the farmers. These assemblers-wholesalers were willing to buy any quantity available because of the great demand in

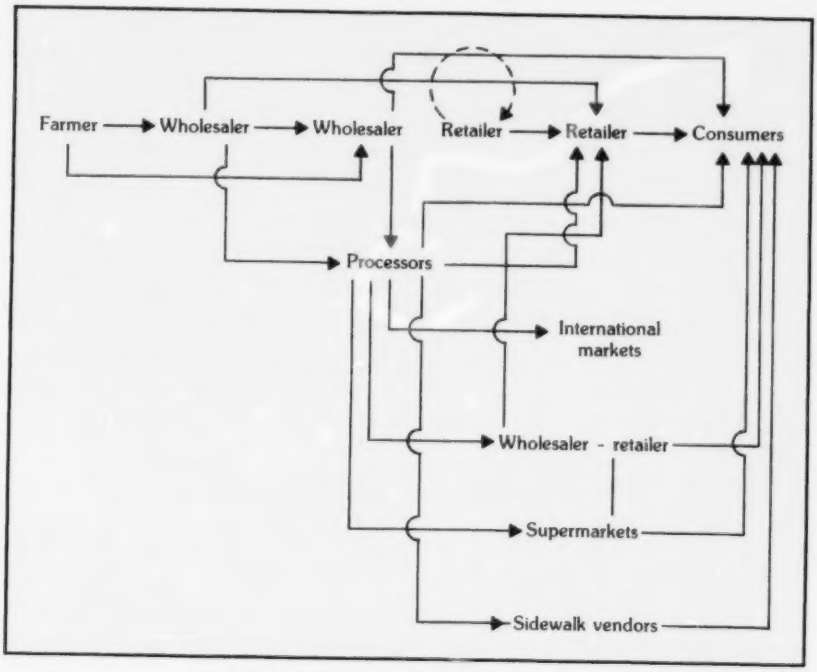

Fig. 1. Commodity flowchart for groundnuts.

the Metro Manila market where most of the processors are found. Trading is monopolized mostly by Chinese intermediaries.

In Isabela, 70% of the groundnuts sold in the market were exported out of the province, whereas 30% was retained for local consumption and for seed use. Groundnuts bought in Isabela are also funneled to other areas of Northern Luzon and Central Luzon.

Current Marketing Practices

Ordinarily, at the farm and trader level, groundnuts are marketed unshelled or shelled. Regardless of quality, size, and number of kernels per pod, groundnuts are never classified or standardized at the farm level before the produce flows to the market outlets. The farmers do not grade the produce, probably because they do not realize yet the benefit of standardization. Few traders perform product standardization either, however, there is no definite criteria established yet to measure quantity or quality.

Price information for groundnuts is not always available. In fact, the lack of price information among private and public agencies inhibits price monitoring at the village, municipal, as well as provincial level. Mostly, the producers are very much dependent upon buyers/traders for any price information. This is one of the reasons why intermediaries often dictate the price they want for the commodity. Information is also gained, but to a lesser extent, from neighbours and the media, specifically radio.

Normally, the groundnut producers deliver directly to the buyer's place of business or sell their produce right at their farm houses. In a survey of two provinces in the Cagayan Valley, 55% of the producers delivered their produce to the wholesaler's warehouses, whereas 45% sold their produce right at the farm.

In places where transport could reach the producer's farms, groundnuts were delivered by truck, jeep, and tricycle. Some producers delivered to the assembly point using animal-drawn sledges, and the produce was later picked up by buyers. Most of the producers sold their produce 2 weeks after harvest.

The Philippine government has been assisting the farmers through the implementation of a food-production program. In the early 70s, groundnuts formed part of the *Gulayan sa Kalusugan* (green revolution). Most of the support programs, however, were geared toward production. Only very limited support was given emphasis in the groundnut marketing system; for instance, in 1981, a support price for unshelled groundnuts was established at PHP 3.91, which was very low compared to the existing price offered by the private sector.

Market Research Methodology

The IDRC-funded project "Groundnut Industry Economics (Philippines)" is a multidisciplinary research project that includes socioeconomic, marketing, biological, and engineering aspects resulting in an integrated research approach with each discipline headed by a specialist. This approach ensures a balance between the different areas of specialization, especially when the research is applied at the village level. The purpose of this paper, is to give a greater insight into marketing research for the groundnut postharvest industry.

The objectives of the case study are

(a) To present a situational analysis of the groundnut industry in the Philippines with greater emphasis on the postharvest marketing discipline,

(b) To discuss intensively the market-research methodologies developed and employed by the project team for the IDRC research-funded project mentioned earlier,

(c) To present initial results and findings gained during the market research on groundnuts in the Philippines, and

(d) To identify general problems and offer possible solutions.

Sampling and Data Collection

Sampling Procedures

To reflect the overall marketing system for the groundnut in the Philippines, all sectors directly participating in the marketing operation were taken to represent the sample population. The sectors include

Farmer level — Peanut-producing towns in the provinces of Isabela, Quirino, Ifuagao, and Cagayan (all found in Northeastern Philippines) were first identified, and sample towns were chosen at random. From among the sample towns, peanut-producing *barangays* were identified and samples were again chosen at random. Finally, from these sample *barangays*, peanut farmers were prelisted and classified into two groups: farmers having groundnuts as a major

crop (accounts for 50% or more of total income) and those having groundnuts as a minor crop (accounts for less than 50% of total income). A total of 269 sample farmers were then chosen at random from both groupings.

Out of the 269 sample farmers, there were 120 farmers planting peanut as their major crop and 149 farmers planting groundnut as a minor crop. Some sample farmers having groundnut as a minor crop had shifted from tobacco farming.

Trader level — The traders to whom the groundnut producers delivered their produce were identified and served as the sample for the trader level. Covering four provinces (Quirino, Isabela, Cagayan, and Pangasinan), a total of 44 traders were taken as the sample respondents for the trader group.

Processor level — Groundnut processors were identified in those areas considered to be the main terminals for the produce. These processors were found by tracing the flow of the commodity starting from the producer level to the trader level and ultimately through to the processors and final consumers. Respondents in this level were mostly obtained in the Metro Manila area, (which is the main trading centre for groundnuts) and some provinces of Central Luzon. The groundnut processors were also selected as the sample respondents in the research study. The types of businesses represented included: primary, 2; secondary-corporation, 3, single ownership, 1; and small scale, 3, for a total of 12.

Data Collection/Analysis

A pretested set of questionnaires, prepared by a multidisciplinary team composed of a management specialist, biologist, market specialist, economist, agronomist, and agricultural engineer, was used as a tool in the gathering and recording of data and relevant market information. A team approach was used at all levels of the marketing operations studied and on all personal interviews with the respondents. Other pertinent information relating to the marketing of groundnuts that was difficult to obtain from the respondents was taken from secondary sources.

Because the Groundnut Industry Economics (Philippines) research project is primarily concerned with analyzing the existing postproduction practices and market profile of the groundnut industry, a simple analysis of data was used. Basically, the data were studied using simple arithmetic means and percentages.

Results Analysis

Farm Level

Four common means of moving the produce were identified: carts and sledges, trucks, tricycles, and *calesas* or jeeps. Of the 269 cases studied, 244 (91%) still use the traditional cart and sledge in transporting the groundnuts from the farm to the farmers' homes or warehouses covering an average distance of 2 km. For those whose farms were more than 10 km away, trucks were used to haul the produce, others used *calesas* or jeeps. The average cost of moving the produce from the farm to the home was PHP 1.44/cavan.

When transporting produce from the farmer's house to the market outlets, a distance of as much as 20 km, most farmers (238 or 88%) preferred to use trucks. For distances covering 1 km or less sledges, tricycles, or *calesas*/jeeps were used.

Table 1. Volume sold, price per unit, and total market value from a survey of 269 groundnut farmers, Cagayan Valley, 1985.

Province	Wholesalers			Wholesalers–retailers		
	Volume (kg)	Price/kg[a]	Total market value	Volume (kg)	Price/kg[a]	Total market value
Cagayan	26290	7.91	207954	2189	8.30	18169
Ifuago	19448	7.84	152472	9922	7.46	74018
Quirino	46813	8.08	378249	770	8.30	6391
Isabela	147884	7.92	1171241	4576	7.60	34778
Total	240435	31.75	1909916	17457	31.66	133356
Average	—	7.94	—	—	7.92	—

[a] 18.72 Philippine pesos (PHP) = 1 United States dollar (USD).

Most of the farmers (172 or 64%), claimed that the delivery of their product to the traders' place of business was done by the buyers, and the average cost of transport was PHP 2.32/cavan.

The usual market outlets for groundnuts were the wholesalers who absorbed roughly 241 $\times$ 10^3 kg of unshelled groundnuts and the wholesalers-retailers who handled more than 17 $\times$ 10^3 kg of the total marketable produce of the farmers studied. At the wholesalers' level, prices ranged from PHP 7.84 to PHP 8.08 for an average of PHP 7.94/kg. The wholesalers'–retailers' prices ranged from PHP 7.46 to PHP 8.30 for an average of PHP 7.92/kg. The overall price, including all outlets, averaged PHP 7.94/kg. The total value of marketable produce amounted to more than PHP 2 million (Table 1). Groundnut production is affected by climatic conditions, in that production during the wet season (201 kg/farm) is very low in contrast to the dry period (766 kg/farm).

Marketable groundnuts normally are stored by the farmers from 1 to 3 weeks after harvest. Of the total 269 farmers studied, 94 (35%) sold the produce 1 week after harvest; 33 (12%), 2 weeks after; 50 (19%), 3 weeks after; 41 (15%), 1 month after; and 51 (19%) sold their produce immediately after stripping the crop.

The most common reason for holding produce for only 1–2 weeks is the loss due to shrinkage that occurs during extended storage and the need for immediate cash. Respondents who sold their produce beyond 2 weeks were waiting for better prices.

The advance payment "tampa" system was practiced between the farmers and the buyers. Twelve percent of the total number of farmers were paid in advance. The interest charges ranged from 30 to 45% for a duration of less than 4 months; the rest, however, were paid in cash.

Information about the marketing and pricing of groundnuts was mainly obtained from the buyers according to about 62% of the farmers, which supports the suggestion that the buyers dictate the prices of the farmers' produce. Of the remaining farmers 20% got their information from other farmers, 13% from neighbours, and 5% from the media.

Results of the survey indicate that the farmers are not aware of any product classification and standardization. Not even one farmer sold groundnuts that were graded or classified.

At the farm level, the main problems were the low price of the product, high cost of transport, price instability, an unreliable weighing scale, the reduction of weight by buyers, and price competition.

Trader Level

There was a total of 44 traders included in the survey from the Cagayan Valley and Central Luzon. Except for one trader who had a partnership business, all the rest were the sole owners or proprietors of their business. Most likely these were family owned and operated businesses.

Farmers are the major source of groundnuts, accounting for roughly 64% of the total volume of operations with the remaining 36% coming from co-traders. The farmers received PHP 8.10/kg compared to PHP 8.65 received by the co-traders. On average, traders were offering a price of PHP 8.38/kg unshelled.

The cost of marketing support facilities on the average per trader surveyed amounted to almost PHP 200 000. The warehouse accounted for about 40% of the total cost with transport costs at about 47% and the remaining 13% being taken up by postharvest facilities. (Table 2).

In terms of drying and storage methods used and duration, except for sun drying over cement pavement, no other drying method was employed by the traders. The traditional method of putting the groundnuts into plastic sacks and storing these inside the warehouses was the common method.

Groundnuts are stored from 1 week to more than 3 months, with 43% of the traders storing the crop for less than 1 week and another 43% for 3 months or more. The remaining 14% stored the crop from 2 weeks to 1 month.

For product disposal, grading, and standardization, normally, most of the traders sold the produce with the shell on, only 7 out of 44 sold shelled produce. When the groundnuts were left unshelled it was because (a) there were no shelling facilities; (b) producers wanted to minimize expenses, time, and effort; or (c) this was the preferred form at the outlet.

As mentioned earlier, grading was never practiced. Some traders, however, did occasionally sort the groundnuts according to size and quality. No specific

Table 2. Marketing support facilities and average value, from a survey of 31 groundnut traders, Cagayan Valley, 1985.

Marketing facilities	Respondents	Number of units	Average value[a]	Percentage
Warehouse	31	31	81135.00	40.79
Transport				
Trucks	27	27	57324.88	28.82
Jeeps	10	10	36500.00	18.35
Drying facilities				
Cemented pavement	17	19	2797.24	1.41
Flatbed dryer	4	4	3799.52	1.91
Sheller	4	4	14771.43	7.42
Weighing scale	31	31	2587.10	1.30
Total	—	—	198915.17	100.00

[a] As of 1986, 18.72 Philippine pesos (PHP) = 1 United States dollar (USD)

Table 3. Outlets of traders and form of product sold, from a survey of 39 traders, Cagayan Valley, 1985.

	Shelled			Unshelled		
	Number reporting	Volume sold (kg)	Sold/kg	Number reporting	Volume sold (kg)	Sold/kg
Direct consumers	—	—	—	2	49800	9.10
Retailers	1	47250	14.28	10	194700	8.83
Wholesalers	—	—	—	38	1896620	8.58
Local market processor	—	—	—	1	60000	9.13
Metro Manila processor	4	107100	14.69	4	540000	9.50
Total	—	154350	—	—	2741120	—

criteria as to the size of shelled groundnuts have been reported. In general, however, they were sorted as jumbo, regular, or small. To determine quality, the major criteria used were moisture content, fullness of pod, and percentage of spoilage.

Most of the traders used co-traders for their outlets. The bulk of the volume went to the wholesaler as unshelled groundnuts accounting for almost 1.9×10^6 kg at an average price of PHP 8.50/kg. Of five traders sampled, one sold shelled groundnuts to retailers whereas four traders sold to the Metro Manila area. The average price for shelled groundnuts was PHP 14.48/kg (Table 3).

The general movement of groundnuts for use as seed is from farmers to traders, traders to co-traders, and then from traders to farmers. The bulk of the produce was moved from traders to co-traders with a total volume of 616 000 kg handled by five traders at a price of PHP 9.44/kg. Seven traders reportedly sold 116 000 kg directly to the farmers at a higher price (PHP 10.25/kg).

Those traders who graded produce simply divided them into large (jumbo) and small (regular). The price received by the traders for large groundnuts averaged PHP 1.060/picul (1 picul = 63 kg) equivalent to PHP 16.83/kg. For the regular groundnuts, the price was a little lower at PHP 960/picul or about PHP 15.24/kg.

The major components of the marketing costs identified in the study included hauling, transport, shelling, and packaging. The price of groundnuts, whether in the shelled or unshelled form, varies from one outlet to another mainly because of the difference in handling services provided by the various series of outlets. The gross price margin between the farm gate and retailer was PHP 0.70; retailer to wholesaler, PHP 0.25; wholesaler to local processors, PHP 0.35; and wholesaler to Metro Manila processors, PHP 0.92. At the trader level, the main problems were no definite grading system exists, lack of government support for the peanut industry, processors are selective in the quality of groundnuts, and the assembly of product.

Processor Level

The 12 processors sampled were classified as being either a corporation (six) or a single proprietorship (six). In terms of the groundnut industry, the 12 processors were further classified into primary, secondary, and small-scale groupings. If the major income were derived mainly from groundnut processing, the opera-

tion was considered to be on a primary scale, the secondary scale referred to an income of less than 50%, and small-scale if family labour were used in the processing operation.

The average monthly volume needed by the processors was 28 837 kg of shelled groundnuts and 13 600 kg unshelled at PHP 19.92/kg and PHP 9.25/kg, respectively, on average. More than 70 000 kg shelled (PHP 21.13/kg) and 30 000 kg (PHP 8.50/kg) unshelled is required by processors whose primary business is groundnuts, whereas almost 15 500 kg shelled (PHP 19.64/kg) and 2000 kg unshelled (PHP 9.75/kg) for those in the secondary group. For small-scale businesses, only 360 kg shelled (PHP 19/kg) and 8800 unshelled (PHP 9.50/kg) were used monthly. Processors get the raw materials directly from traders in Metro Manila (especially at Divisoria), Central Luzon, or the Cagayan Valley regions.

The 12 traders surveyed based their choice as to where they get raw materials on the basis of quality of product, low price offered, and whether the product could be delivered directly to the processor's place of business. Nine out of the 12 processors purchased raw materials based primarily on the quality of the groundnuts.

Like the traders group, the processors classified the raw materials in terms of quality and size. No clear-cut measurement criteria, however, was identified. The groundnuts are classified again before processing. To sort the groundnuts, the classifiers used vibrating screens, manual kernel size selection, and visual inspection.

Rejected groundnuts were used in various ways, although most of the processors returned the rejected product to the suppliers. Some used these for feed and fertilizer, whereas the others just threw them away or sold them at lower prices.

Processed groundnuts took the form primarily of groundnut butter, brittle, and salted groundnuts, followed by coated groundnuts and other confectioneries.

Various outlets were used as the markets for the processed product, which include direct consumers, retailers/wholesalers, supermarkets, sidewalk vendors, and the international market. About 41% of the 12 processors surveyed used the supermarkets as their major outlets. Four out of 12 processors sold the product to wholesalers, whereas three processors sold directly to retailers. Two processors utilized the international markets for their processed products. The others used the sidewalk vendors and sold directly to consumers.

The sales methods used were through consignment, cash on delivery, freight on board, and credit. About 67% of the processors sold the product cash on delivery, whereas 50% sold on credit payable 15 days after delivery. Two out of 12 sold freight on board, whereas only one sold through consignment.

Processors selected their respective buyers for the following reasons: (a) familiarity with buyer, (b) centralized market (institutional), and (c) business partner.

The pricing strategies commonly employed were quantity discount and cost of production plus a certain profit margin. Eleven out of 12 processors priced their product based on cost of production plus a desired level of profits. Only one, however, depended entirely on the quantity discount. As the volume purchased increases, a higher percentage of quantity discount is offered by this processor.

The media used in promoting the product included print, broadcast, and outdoor advertising and personal selling.

Regardless of the form of business organization, almost all the respondents (83%) were financed through equity, whereas 17% were financed by borrowing.

Most of the processors claimed that they were not aware of any government programs and policies that affect the groundnut industry. Of the 12 processors, 9 were not aware of the existence of such programs and policies.

At the processor level, the main problems were

(a) On procurement: maturity of groundnuts, lack of capital, infestation, lack of sufficient supply (quality), and no quality controls.

(b) Processing: poor quality, presence of aflatoxin, seed classification, and source of fresh peanuts for "salted" varieties.

(c) Packaging and sales promotion: high price of container, inconsistent performance of labourers, and competition.

RECOMMENDATIONS

The Philippine Groundnut Industry, from the industry viewpoint and analysis of the key factors affecting its marketing systems, requires immediate attention. Generally, there is no systematic marketing system and, therefore, specific problem areas must be investigated further.

Phase I focused on the establishment of the market profile of the groundnut crop and the identification of key problems, therefore, no application of research results could be recommended yet for the improvement of the industry. Marketing research developmental studies must be continued to establish dependable marketing strategies for the groundnut crop whether in its raw or processed form.

Studies that need further investigation (hopefully in Phase II) would include the following because these are the most critical areas in the marketing system:

(a) Evaluate the existing policies and programs of the Philippine government as it affects the marketing system of groundnuts. An investigation of present and past programs and policies would allow planners and implementors to identify their applicability for the improvement of the industry. Such policies could be redirected to fit the real needs of the industry and formulate better policies and programs.

(b) Further development of the grading and pricing standardization system. In Phase I, this was identified as a major problem among farmers, traders, and processors. There is a need to identify what grading system could be applicable to all levels of the marketing operation.

(c) Development of better groundnut marketing strategies at the village level. A marketing model that would increase the bargaining power of the groundnut farmers will be established and developed. One approach is a viable marketing association for groundnuts.

Investigating the Market Structure for Fish in Malaysia

Fish marketing was comprehensively studied in Peninsular (or West) Malaysia during 1983–85. A simpler study has been designed to be carried out in Sri Lanka in 1986–87. The objectives, methodology, conduct, and findings of the Malaysia study are explained. A range of related issues, which did not arise directly from field research, are discussed. To provide comprehensive profiles of key dimensions and characteristics at all levels of particular marketing chains, a series of model-industry organization charts is proposed for future product-marketing studies. The proposed dimensions include volume produced, imported and exported; seasonal and lunar cycles; species mix; trade participants; prices, costs, and margins; product usage; postharvest losses in volume and quality; and changes in the form of the product(s). Suggestions are offered concerning the design, conduct, and control of studies of the marketing of fish and agricultural products in developing and developed countries.

The fisheries subsector of Peninsular (or West) Malaysia employed 2.7% of the national workforce in 1982, but its contribution to gross domestic product (GDP) was only 0.8%. Fish landings in the same year totaled 567 300 t (metric tonnes), of which 69.4% was sold in the domestic and export markets as fresh fish (nearly all as fresh, iced fish), 13% was processed for human consumption, and the rest was employed in the manufacture of foodstuffs or used as manure. Imports, mostly from Thailand, were equal to 39.2% of local consumption in 1982 according to figures from the Department of Statistics. Between 1971 and 1978, fish provided some 14% of the domestic protein intake (Chong 1982).

Despite the economic importance of marine fisheries, this subsector is widely considered to be suffering from serious deficiencies: a large proportion (about 40%) of the fishermen are living in poverty (in Malaysia, the poverty line is drawn at MYR/month [at 1983 prices] for an average household of 5.3 persons, and in 1983, the average value of the Malaysian ringgit [MYR] was MYR 1 = 0.4 United States dollar [USD]), there is a very uneven distribution of the subsector's income between producers and traders, there are unduly heavy postharvest losses, and there are serious flaws in the marketing system. The roots of these problems are said to originate from both production and marketing weaknesses. The linkage between the level of production efficiency and the level of the incomes of boat owners and fishermen is direct and comprehensible. The relationships between

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changes in market variables and structures and their impact on producers and consumers are, however, difficult to identify and they are subjective. For instance, it is frequently alleged that "middlemen" constantly exploit fishermen through the fixing by the former of unduly low prices, as well as charging exorbitant rates of interest on advances for boats, hulls, nets, fuel, and so forth (Jahara Yahya 1976). The allegations are usually in vague terms and rarely empirically proven, let alone critically justified, in terms of the middlemen's major contribution to the provision of basic marketing time, form, and place utilities to producers and consumers.

Presumption, but not verification, is usually made concerning the oligopsonistic and monopsonistic structures of the fish market that, supposedly, have resulted in unbalanced bargaining power between buyers and sellers and, hence, the unequal and inequitable distribution of costs and profits among the various market participants, including transporters. The literature (Jahara Yahya 1976; Lim 1976; World Bank 1983) signally fails to prove the empirical relationships that are so frequently postulated.

The government, which at least until recently subscribed to the above conventional wisdom, initiated in the 1970s a range of production subsidies and marketing intervention arrangements in an attempt to promote efficiency and alleviate poverty among fishermen. Marketing intervention still takes the form of encouraging, rather firmly, the fishermen to participate directly in fish trading through cooperatives and associations and providing landing jetties and complexes and other kinds of infrastructure (Lockwood 1983). With very few exceptions fishermen's cooperative programs were unsuccessful (Lim 1976).

The fish market continues to exhibit pronounced price instability and, it is alleged, this is much to the disadvantage of producers and consumers and to the benefit of market intermediaries, who are widely believed to prosper from it. The government, under its New Economic Policy (covering the period 1971–90), is seriously concerned about the need to increase the rate and extent of poverty alleviation among fishermen. On the unproven premise that marketing problems are largely responsible for the limited achievement in poverty eradication, the two official fisheries institutions — Fisheries Division of the Ministry of Agriculture (FD) and the Fisheries Development Authority (LKIM) and the International Centre for Living Aquatic Resources Management (ICLARM) in 1983 jointly agreed on the need to examine closely the fish-marketing system. In the early stages of the study it seemed certain that three universities would pool resources to carry out the investigation. Eventually, the Faculty of Resource Economics and Agribusiness of Universiti Pertanian (UPM) agreed to provide a seven-graduate team to conduct the study.

On the completion of the design and fieldwork of the study, the UPM team was asked to advise on the design and conduct of a similar, but much more limited, study of the Sri Lanka fish-marketing system.

This paper summarises UPM's experience in carrying out the Malaysia fish-marketing study, especially with regard to the methodology employed and problems encountered. Reference will be made to experience gained from the ongoing Sri Lanka study. The first section of the paper provides an account of the various aspects of the research design and conduct. The problems encountered and findings are discussed in succeeding sections. In the final section, some suggestions are offered for the benefit of those who may be involved in the design and

conduct of similar studies of national or regional marketing systems for fish or other agricultural products.

Research Design and Conduct

Scope of the Study

The overall objectives of the Malaysia study were to obtain comprehensive data on the fish-marketing system, provide a review basis for policymakers, and make recommendations for improving market performance. The operational objectives of the study were as follows:

(a) To describe and quantify the physical flows of marine fish from landings to final consumer outlets;

(b) To describe and quantify the stages in the market chain and obtain information on the numbers and throughputs of intermediaries/traders and other participants;

(c) To assess the adequacy of the market infrastructure in handling the transferring fish from landings to consumer outlets;

(d) To describe and quantify the components of the market and explain their relationships;

(e) To describe the extent of product differentiation such as sorting by species/grade and size at each stage of the market chain;

(f) To determine the nature of competition and measure the degrees of concentration and the extent of monopsony at various market levels;

(g) To identify the nature and sources of barriers to entry that confront aspiring market participants; and

(h) To ascertain the cost of providing various marketing functions like transportation and storage, calculate the extent and cost of wastage, estimate the profit margin of the main types of market intermediary, and estimate the producer's share of the retail price.

Theoretical Framework

The study team set out to examine the relationships between structural dimensions of the fish market as well as the conduct of the major market participants. These data were to make it possible to consider the overall performance of the industry in respects such as economic and general efficiency, technological progressiveness, income distribution, and price stability and the like. Thus, the industrial organization structure-conduct-performance model appeared to be appropriate for the investigation. The study included an evaluation of the observed structural, behavioural, and overall performance of the market, using appropriate benchmarks (or criteria) of workable competition developed particularly by Sosnick (1985, 1968), Bain (1967), and Scherer (1980).

Data Source

Primary and secondary data were employed for the study. Primary data were needed to quantify the physical fish flow, market structures, and conduct, and,

finally, the marketing infrastructure, costs, and margins. Secondary data were necessary to provide background information and fundamental statistics of the marine fisheries industry, particularly on landings and imports.

Primary data of two types were collected. First, continuous records relating to volumes, values, and species in selected weeks in a year of fish catches at chosen landing complexes, along with similar data about the corresponding arrivals in terminal markets as well as in import and export centres. These data were meant to capture the seasonality and species mix of the fish supply and the impact on prices, as well as ascertain the structural characteristics of the major fish traders. The above data set was collected by means of structured formats completed by selected respondents on a daily basis at specific locations for a week in every month over a period of 1 year. The survey was spread over a year to ensure that seasonal variations in the fish supplies (because of the effects of the monsoons) were captured in the study. The survey weeks were selected to take account of lunar phases and thus, allow for the fact that at full moon catches are considerably less frequent and smaller than when there is little or no moonlight.

The questionnaire pro formae were of different colours to distinguish between the different levels of the market, i.e., white for landing complexes, pink for inland wholesale markets, yellow for imports, and green for exports. The more important data elicited from these formats included quantities, prices, and species bought or imported and sold or exported at the chosen locations.

Questionnaires were also used by the UPM researchers to interview and record the modus operandi of traders at the primary market level. A random sample of 45 primary wholesalers from the selected LKIM landing complexes and 53 wholesalers from the selected non-LKIM complexes were interviewed using a structured questionnaire. Interviews were conducted only once as it was felt that the behavioural pattern of traders was unlikely to change significantly over the survey period. The structured questionnaire was applied to primary market traders, partly to test the widespread allegation that they make exorbitant profits from, and act oppressively against, producers. In addition, the questionnaire was used to ascertain and explain the linkages between producers, primary traders, and terminal traders. A schematic summary of all the data sources is given in Fig. 1, and the following is a summary of details of types of information collected from primary wholesalers using a questionnaire:

- Socioeconomic characteristics of traders: (a) business and economic functions performed, and (b) details on the types of boats owned/operated by traders.
- Marketing practices of the wholesalers: (a) sources of supply and methods of buying and selling; (b) marketing channels employed; (c) types and nature of business relationship (particularly credit relationship) between suppliers and wholesalers, among wholesalers themselves, and with other traders/clients from other major terminal markets; (d) method of price determination; (e) marketing costs and margins; (f) availability of storage facilities; (g) rate of fish spoilage; and (h) methods of payment.
- Details on type of facilities owned by the wholesalers.

The structural formats were completed every month from December 1983 to November 1984. The pretesting of the questionnaire was carried out in April 1983, and the interviews were conducted in January and February 1984.

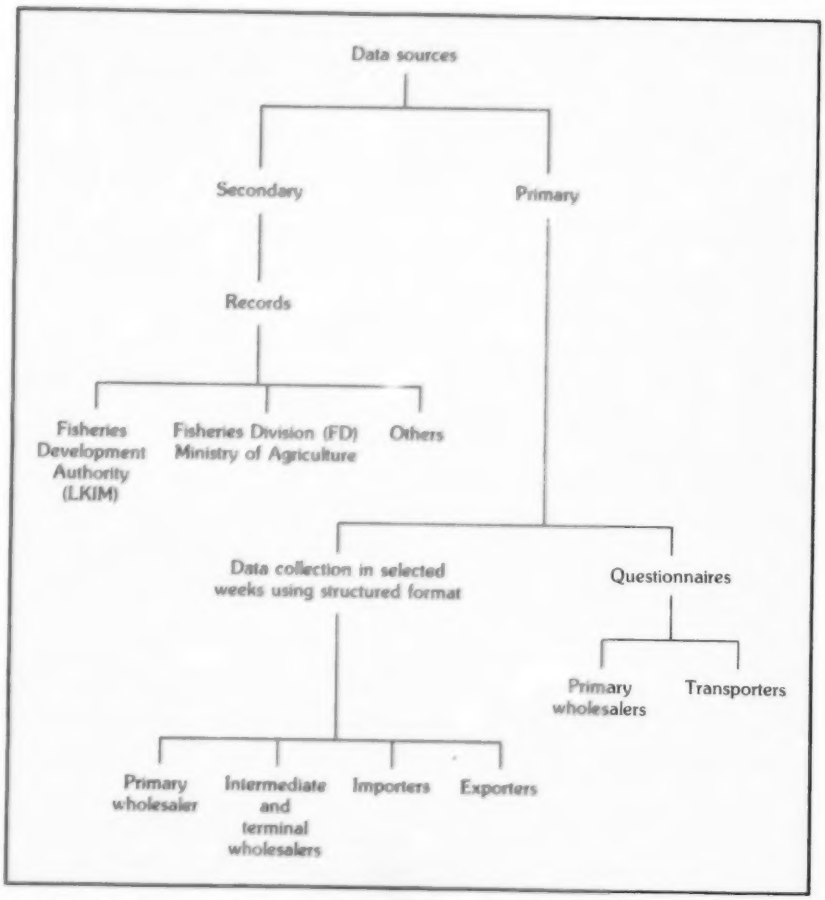

Fig. 1. Schematic summary of data sources used in the fish marketing study in Peninsular Malaysia, 1983–84.

Sampling Procedures

The stages involved in the sampling procedures are depicted in Fig. 2 (a, b). With a small number of exceptions multistage stratified random sampling was employed. Two types of sample were needed for the study, one for the year-long survey, using structured formats, and one for the survey on primary-market traders, using a questionnaire. The former involved first the selection of major landing centres, import and export points, and intermediate and terminal markets. LKIM provided the sampling frame and advised on the volume traded and the various activities of the major centres. For instance, the five fish-landing centres chosen were believed by LKIM to account for about 70% of landings in the LKIM-controlled areas. From each selected centre, a sample of market intermediaries was chosen. The selected respondents agreed to provide consistently and regularly all the data sought in the structured formats for the 1-year period. The samples of landing centre traders consisted of a representative 56% of the total population (Table 1).

Table 1. Number of samples chosen at landing complexes and wholesale fish markets, Peninsular Malaysia, 1983–84.

Traders	Sample	Population	Percentage of sample to population
At landing complexes			
Kuala Trengganu	9	28	32
Pulau Pangkor	14	19	74
Kuala Kedah	21	21	100
Hutan Melintang	7	21	33
Mersing	10	20	50
Subtotal	6	109	56 (average)
At intermediate and terminal markets			
Ipoh	8	n.a.[a]	—
Kuantan	5	n.a.	—
Kuala Lumpur	24	n.a.	—
Alor Star	18	n.a.	—
Malacca	5	n.a.	—
Johor Bahru	52	n.a.	—
Subtotal	112	—	—

[a] n.a. = not available.

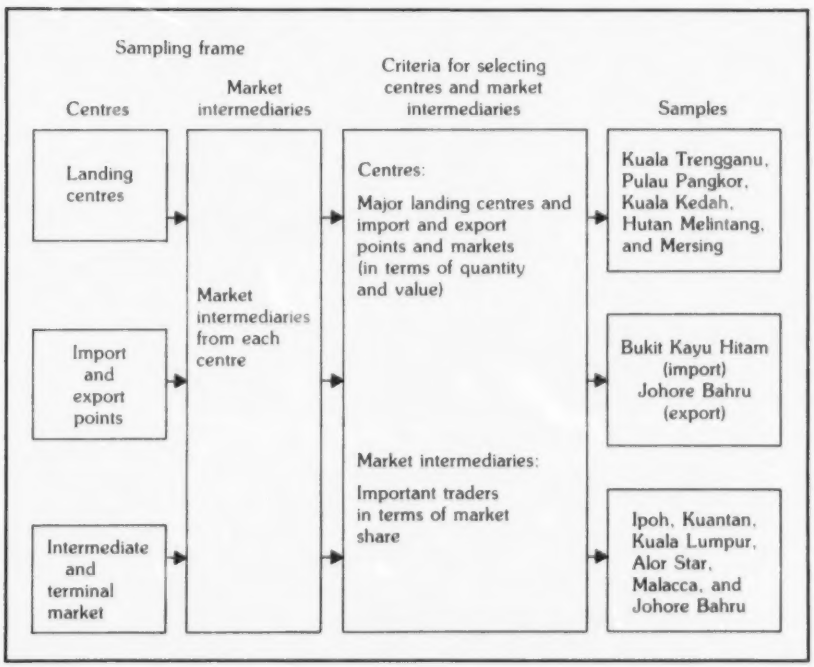
Sampling frame
Centres
Market intermediaries
Criteria for selecting centres and market intermediaries
Samples
Landing centres
Import and export points
Intermediate and terminal market
Market intermediaries from each centre
Centres:
Major landing centres and import and export points and markets (in terms of quantity and value)
Market intermediaries:
Important traders in terms of market share
Kuala Trengganu, Pulau Pangkor, Kuala Kedah, Hutan Melintang, and Mersing
Bukit Kayu Hitam (import) Johore Bahru (export)
Ipoh, Kuantan, Kuala Lumpur, Alor Star, Malacca, and Johore Bahru

Fig. 2. (a) Selection of samples for the year long survey using structural formats.

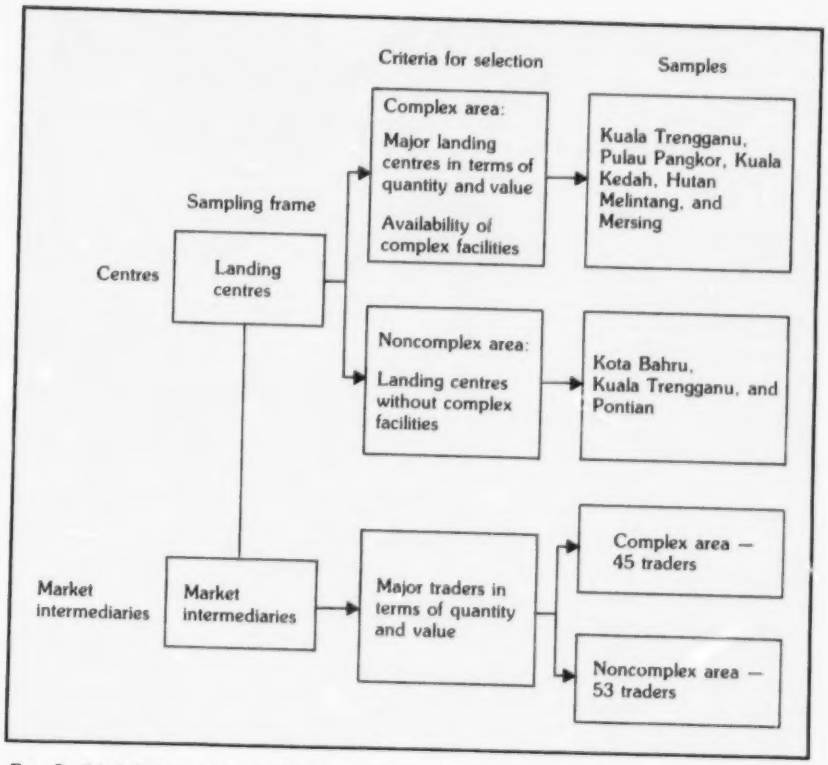
Criteria for selection
Samples
Complex area:
Major landing centres in terms of quantity and value
Availability of complex facilities
Kuala Trengganu, Pulau Pangkor, Kuala Kedah, Hutan Melintang, and Mersing
Sampling frame
Centres
Landing centres
Noncomplex area:
Landing centres without complex facilities
Kota Bahru, Kuala Trengganu, and Pontian
Market intermediaries
Market intermediaries
Major traders in terms of quantity and value
Complex area — 45 traders
Noncomplex area — 53 traders

Fig. 2. (b) Selection of samples for the questionnaire–interview survey of primary market traders.

The selection of the landing centres was confined to LKIM-complexes, with the exception of Hutan Melintang where the majority of the jetties were privately owned. This was because first, at private complexes, information on trading activities was not likely to be provided. Second, the study team relied on the enumerators from LKIM to collect the data from the centres, thus by choosing LKIM-complex centres, this reduced labour constraints.

For the survey on primary markets, the sample of traders were selected from the five identified major landing centres employed in earlier sampling. The sampling frames used both for landing centres and their market traders were also similar to the ones used earlier. Members of the study team interviewed the same sample of traders that had earlier provided responses to structured formats. This procedure was followed to study the correlation between the physical flow of fish and the marketing practices of traders. The number of traders interviewed at the landing centres accounted for a representative 41% of the total population (Table 2).

There was no sampling frame for traders in the areas that had no landing complex facilities, and respondents were selected randomly at the three chosen areas. Some 45 primary wholesalers from the landing areas with complexes and 53 traders from the landing areas without complexes were interviewed.

Table 2. Number of primary traders chosen at landing centres, Peninsular Malaysia, 1983–84.

Traders	Sample	Population	Percentage of sample to population
At landing complexes			
Kuala Trengganu	6	28	22
Pulau Pangkor	13	19	70
Kuala Kedah	9	21	43
Hutan Melintang	10	21	48
Mersing	7	20	35
Subtotal	45	109	41
With no landing complex facilities			
Kota Bahru	19	n.a.[a]	—
Kuala Trengganu	18	n.a.	—
Pontian	16	n.a.	—
Subtotal	53	—	—

[a] n.a. = not available.

Data Collection

The interview team consisted of seven researchers and three research assistants. The collection of data for the year-long survey was conducted by LKIM enumerators at the chosen localities from December 1983 until November 1984. The enumerators received a week's training, mainly on the methods of interviewing and collecting of data from the respondents. The minimum qualification of the enumerators was the MCE (Malaysian Certificate of Education). Schedules of survey weeks were sent to the LKIM field staffs concerned, and reminders were relayed before the start of each survey week. The completed questionnaire forms were analysed by UPM specialists. The control of enumerators other than UPM personnel posed few problems. The completed forms were at times incomplete, submitted late, or were unsatisfactory in other ways. This was probably because of the inexperience of the enumerators, poor communication, poor control, or other constraints. The survey on the primary market traders was carried out by the seven researchers themselves.

Data Processing and Analysis

An enormous amount of data was generated by the study, given the different locations evaluated and the frequency and diversity of the formats used. The data were not analyzed by computer because of numerous frequencies involved as a result of the wide diversity of species of fish landed at the various landing centres. Reluctantly, the team found it necessary to summarize the data manually on those species that are traded on a weekly basis. By analyzing the data manually, the costs for data processing were minimized. Nevertheless, the manual computation posed two major setbacks — a delay of nearly a year as well as a disturbing range and number of errors. The data from the survey on the primary market traders were analyzed by computer.

Problems Encountered in the Study

The fish-market structure, conduct, and performance had never been studied comprehensively in Peninsular Malaysia, so this was the first attempt to

examine empirically the physical flow of fish in this country. Furthermore, the study was wide in scope and complex in nature, covering the structural and behavioural dimensions of the market, i.e., areas that were subjective and difficult to quantify. Despite careful planning and the meticulous pretesting of questionnaires and formats, some difficulties were encountered that should really have been anticipated. The problems were as follows:

(a) Responses were inadequate and inconsistent — The responses to structured formats used in the year-long survey were sometimes inadequate and inconsistent. The study team was unable to extract a complete set of data on quantities, species, and prices of fish traded during the 1-year period. The enumerators in Kuala Trengganu fish-landing centre failed to persuade the local traders to disclose the prices returned to them for fish consigned to terminal market wholesalers. Prices, it appeared, were regarded by the Kuala Trengganu traders as business secrets, the revelation of which would jeopardize their competitive position in the market. On the other hand, these prices were vital to the study for price and margin analysis. The members of the study team made return visits to each landing centre (in September 1985) to test the reliability of certain data, particularly on marketing costs and prices. The data recorded in centres other than Kuala Trengganu were found to be satisfactory and reliable.

There were some inconsistencies in the standards of reporting data by the traders; that is, some enumerators failed to collect the necessary data from the chosen traders consistently and in the selected weeks over the 1-year period. The difficulties may have arisen because the said traders were not transacting business in the selected study week, or because the enumerators failed to meet the traders at the agreed time and place. To ensure the reliability of data, the study team deleted those cases on which they had serious doubts, especially those where traders had given answers that were inconsistent or doubtful in other ways. The survey on the primary market traders yielded results that overall are considered to be quite satisfactory. The poor response to the structured formats were mainly because of unsatisfactory control and supervision of the enumerators by particular study-team members. The team members should each have checked the data obtained by the enumerators from time to time and visited the landing centres and verified the data. (The study team only realized the inadequacy of data at the end of the collection period.) Spot checks on the enumerators would have ensured that they performed their task accurately and efficiently.

(b) Sampling of traders from areas without complex facilities was not satisfactory — the request to include a study of traders from areas that do not possess landing complex facilities was imposed on the study team late in the study period by one of the sponsors, LKIM. UPM had insufficient specialist labour for this work so LKIM undertook this particular part of the survey. The inclusion of this area was felt by LKIM to be necessary to be able to compare the behaviour of noncomplex traders with that of traders at the complexes.

The results of this part of the survey leave no doubt that LKIM failed to employ satisfactory sampling methods. One objective of the study was to examine, by using questionnaire interiews, the behavioural aspects of traders; i.e., the sample unit was intended to be actual traders and not producers. However, some 87% of the respondents interviewed from the landing areas without complex facilities were in fact small-scale producers! Hence, most of the responses summarized in Appendix E were irrelevant and inapplicable. In any case, the pseudo

comparison of the behavioural characteristics of traders at complexes with those at noncomplexes was meaningless. This problem could have been avoided if proper sampling procedures had been followed by the responsible institution. Again, close supervision and spot checks would have detected the weakness and enabled remedial measures to be taken.

(c) Margin of error through computation was large — until the closing stages of the data analysis, the study team believed that manual computation would handle the massive data generated from the study as efficiently as computerized calculation. Only when confronted with both numerous inconsistencies as well as errors in the data were the advantages of computer usage appreciated. Nevertheless, by employing three full-time graduate research assistants for a total of 12 months it was possible to cope satisfactorily with the errors and queries.

Manual computation was employed in the erroneous belief that it would be the most economical method. In fact the cost of manual data processing amounted to MYR 18 298. (During the study period the value of the Malaysian ringgit fluctuated considerably, averaging MYR 2.5 = USD 1.) As things turned out, the cost of utilizing electronic computer facilities would have been substantially less than this figure. As already mentioned, there would have been a significant saving of time as well as a higher degree of reliability.

(d) A single 1-year study period is insufficient for assessing key areas — because of time constraints the study team had to confine fact-finding to 12 months of fish landing and marketing in the hope of ascertaining all the dimensions, characteristics, and implications of seasonality. Such are the year-to-year monsoonal and other variations that 12 months is too short a period to ascertain the seasonal and cyclical trends. To examine all aspects of the nature of the crucial area of seasonality, it is necessary that the study be repeated at least twice, with improvements in methodology and in the range of data to be collected.

A study such as the Malaysian one mainly provides some still photographs of fish marketing. Ideally, such a piece of research should reveal the nature, pace, magnitude, and causes of changes taking place, such as in market shares, products, packaging, sorting, grading, processing, quality, transportation, and storage as well as in trade expenses and profit margins. Ongoing changes and their consequences should also be discussed, especially their implications for producers and consumers.

(e) Changes in the leadership and composition of the study team should be minimized — many developing countries are particularly short of experienced, well-trained agricultural economists in general and of agricultural marketing economists in particular. This constraint, which is very severe in Sri Lanka, was also important in the Malaysian study. The latter began as a joint study by three universities but was eventually done by UPM. The role of leader-coordinator was held at different times by three different persons and, although most of the important research was done by 7 UPM graduates, more than twice that number were members of the team at one time or another. Without offering hard and fast suggestions we would merely outline the need that is given in this subheading.

(f) Study teams require part-time specialist members — with hindsight based on the Malaysian and Sri Lankan studies we recommend that there should be continuous but part-time inputs by specialists in human nutrition (medical and food science) and postharvest losses (food science and technology).

(g) Objectives should include the compilation of a range of marine fisheries flow charts. A study should enable tables and diagrams to be compiled to provide the following profiles: time flow of fish caught in particular areas showing at each stage, the time and the weight and the quality assessment of the products; and the expenses (including losses of weight and quality) and net profits accruing at each stage of the market chain.

Findings of the Study

Despite some weaknesses, the study revealed many valuable empirical insights into the fish distributional flows as well as the structural and behavioural dimensions of the marketing system. The findings did more than fulfill the basic objectives of the study. The following are some of the more significant conclusions that have direct and important policy implications for marine fisheries in Peninsular Malaysia.

Distributional Flow of Fish

The study results made it possible to trace the pattern of fish distribution from the landing points to the main domestic and export terminal markets. For instance, it was observed that the west coast landing centres serve the western and relatively close terminal markets like Ipoh, Kuala Lumpur, Johor Bahru, Seremban, and Penang. No physical flow of Malaysian fish to the east coast was traced, even during monsoons. It was also noted that a large portion of the Singapore supply emanated from the east coast landing areas. The examination of the source of supply to the six major wholesale centres (Kuala Lumpur, Johor Bahru, Ipoh, Kuantan, Malacca, and Alor Star) indicated that Thailand accounts for 45% of the fish supplied to those wholesale centres.

In terms of grades of fish traded in the major market centres, it was found that, on the whole, Grade 3 fish by far is the important grade constituting 69.4% of the total volume. The proportions of grades varied considerably from market centre to market centre. For instance, in Ipoh, some 52% of the fish sold was of Grade 1, but the proportion was 20% in Kuala Lumpur and it was a mere 1.9% in Johor Bahru. The reason for the low percentage of Grade 1 fish in Johor Bahru could well be that the nearby relatively wealthy and more quality-conscious Singapore market effectively siphons-off the premium grade.

The study showed that during the 1-year period studied, the volume of fish handled fluctuated considerably, reaching its peak in January, May, August, and November (Fig. 3). From the graphical analysis it is clear that the supply of fish from the studied centres is highly volatile, hence the inability to provide a consistent volume and species mix to the market and the resultant price instability. The same pattern is observed in the pattern of fish imports (Fig. 4).

Socioeconomic Characteristics of Fish Traders at Landing Complexes

A structural analysis of fish production yielded important new evidence. A dissection of the socioeconomic characteristics and functions of the fish traders at complexes revealed that 88% of them were boat owners (both operator and nonoperator). Besides performing production and marketing functions, some traders own ice-making machinery, ice crushers, and transport companies and

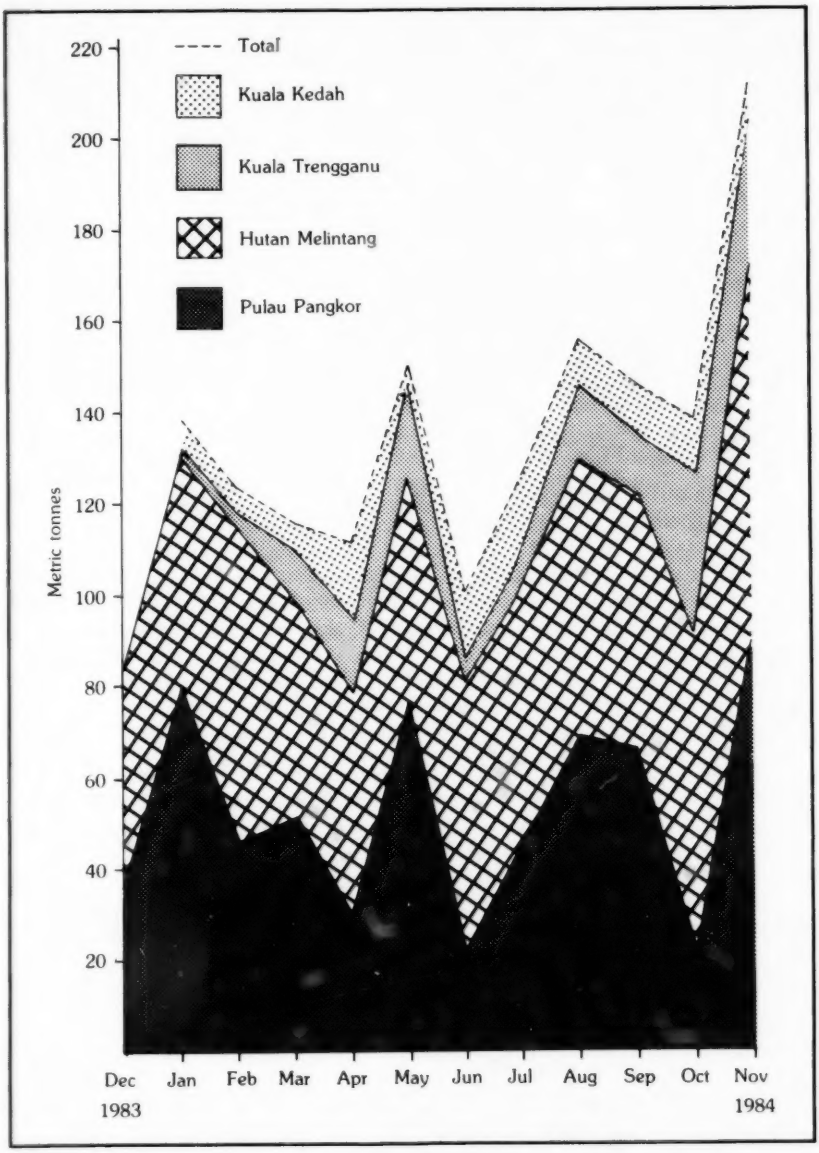

Fig. 3. Fish handled commercially during survey weeks at four selected landing complexes in Peninsular Malaysia from December 1983 to November 1984.

they supply inputs to fishermen. The combinations of function performed by primary wholesalers are numerous (28 types of combinations of functions were reported) and each is almost unique. The overwhelming majority of these traders are Chinese (71%), had been in the fish business for many years, were active members of wholesalers' and marine producers' associations, and owned rela-

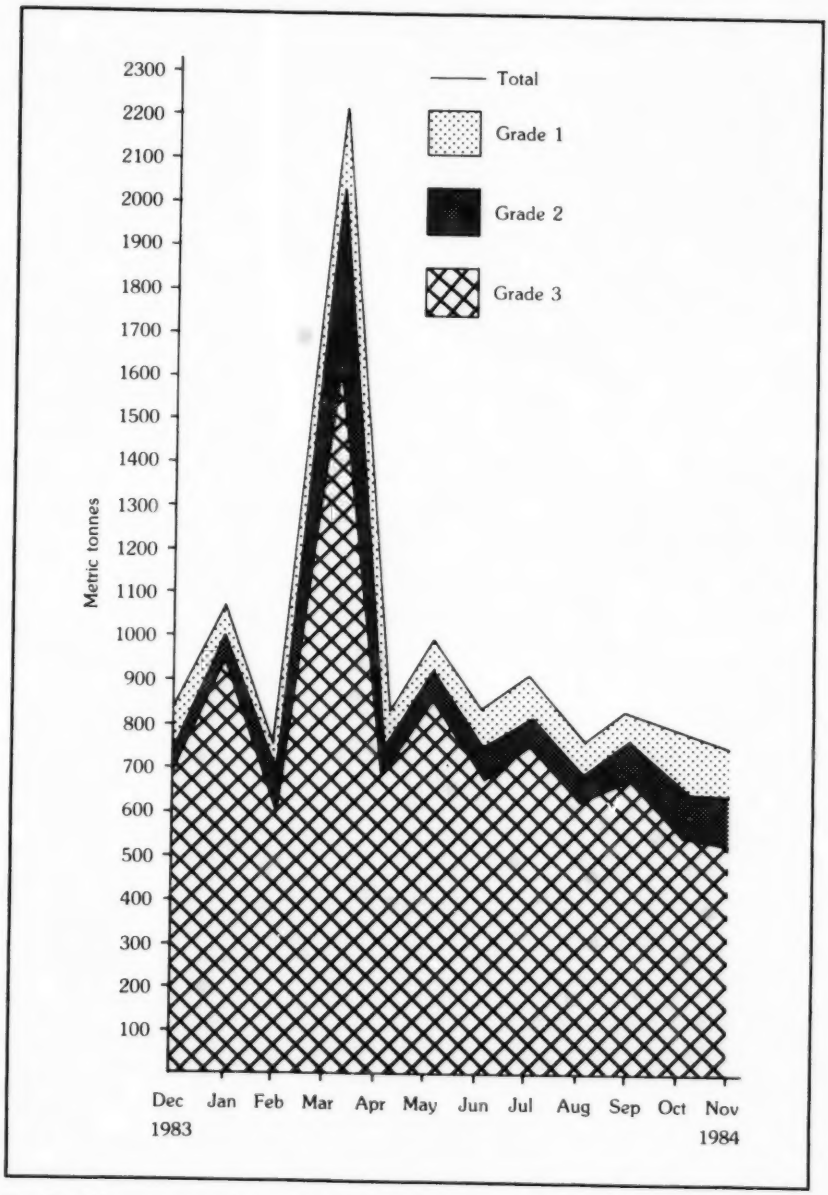

Fig. 4. Fish imports by grade through Bukit Kayu Hitam, Peninsular Malaysia from December 1983 to November 1984.

tively sophisticated large vessels. Clearly, a high degree of vertical integration occurs among these dynamic and innovative industrial producers, a phenomenon rarely found in noncomplexes and other small landing centres.

Fish Market Structure

The study produced some valuable empirical evidence on the significant structural dimensions of the fish market with respect to the degree of concentration among the traders and on the nature and extent of barriers to entry. The degree of concentration among the traders was measured by using the Concentration Ratio and Herfindahl Index (Greer 1980). This index is zero in a perfectly competitive market and one when a trader is either a monopsonist (the only buyer) or monopolist (the only seller). If all firms of traders in the market have an equal share, the index would equal 1/n, which is the inverse of the total number of firms. The study shows that at the primary wholesale level the markets are highly oligopolistic, i.e., the markets are very concentrated, with a very small number of traders controlling the fish trade in each centre. For instance, in Hutan Melintang, the seven largest traders handle almost 100% of the catch, and a similar situation was observed in the other four landing complexes that were studied. The highly concentrated primary markets are complemented with equally concentrated market power in the intermediate and terminal markets, as well as in importing, exporting, and transportation (Table 3).

The major barriers to entry observed were, firstly, the almost total ethnic domination by the Chinese at every level of the market and in transportation. For instance, this community group accounted for 71% of the primary wholesalers, 94% of the terminal wholesalers, 96% of the exporters, and 83% of haulage firms (Table 4). A corollary to ethnicity, is language (Chinese), which also acts as a

Table 3. Concentration ratios and herfindahl indices for complex primary wholesalers (based on quantity handled) terminal market wholesalers, transporters, and exporters, Peninsular Malaysia, December 1983–November 1984.

Type of trade in each centre	Concentration ratio		Herfindahl Index	
	Four traders (%)	Eight traders (%)	Four traders (%)	Eight traders (%)
Complex primary wholesalers				
Pulah Pangkor	58	86	0.092	0.104
Hutan Melintang	81	100[a]	0.169	0.194[a]
Mersing	61	92	0.113	0.138
Kuala Trengganu	72	99	0.134	0.157
Kuala Kedah	65	87	0.109	0.073
Terminal market wholesalers				
Alor Star	50	67	0.048	0.063
Malacca	81	—[b]	0.164	—[b]
Ipoh	82	—[b]	0.188	—[b]
Kuantan	96	—[b]	0.294	—[b]
Johor Bahru	62	77	0.128	0.132
Kuala Lumpur	34	58	0.029	0.044
Transporters	68	96	0.134	0.157
Exporters				
Bukit Kayu Hitam	96	100	0.390	0.391
Johor Bahru	45	70	0.052	0.068
Other areas	36	62	0.034	0.051

[a] Based on seven wholesalers.
[b] There were only 5 wholesalers.

Table 4. Ethnic concentration at various levels of fish marketing, Peninsular Malaysia, December 1983–November 1984.

Market level	Ethnic group		
	Malay	Chinese	Total
Primary number	13	32	45
	(29.9)	(71.2)	(100)
Volume handled per year (metric tonnes)	19.5	1274.2	1469.9
	(13.3)	(86.7)	(100)
Terminal number	7	106	133
	(6)	(94)	(100)
Volume handled per year (metric tonnes)	298.0	6078.4	6376.4
	(4.7)	(95.3)	(100)
Export number	1[a]	23	24
	(4)	(96)	(100)
Volume handled per year (metric tonnes)	34.5	612.8	647.3
	(5.3)	(94.7)	(100)
Transportation number	1	6	6
	(17)[a]	(83)	(100)
Volume handled per year (metric tonnes)	0.2	10.8	11.0
	(2.1)	(97.9)	(100)

Note: Figures within parentheses are percentages.
[a] Persatuan Nelayan (Fishermen's Association).

barrier in regard to domestic and external trading. For instance, the chief export outlet is the heavily Chinese-dominated Singapore wholesale fish market. The exporters of the predominant fish supplier, Thailand, are also virtually all Chinese. Thus, to engage in importing and exporting, contacts and relationships will be much easier for Chinese Malaysians. Other barriers to entry are licencing, high capital requirements, long business and fish trading experience, intimate personal knowledge of customers and suppliers, modern telecommunication linkage, and willingness to work unsocial hours in unsocial working conditions, and unsocial areas.

Market Conduct

The preceding barriers to entry profoundly influence the pattern of behaviour among market traders. There is a strong linkage between particular pairs of market participants, and it extends from the production point through to the terminal market and on to retailers, caterers, and institutional buyers. For instance, to secure consistent supplies of particular kinds and quantities of fish, the primary market wholesalers normally purchase both on forward-contract terms and on a direct-consignment basis, resulting in strong, though not legally binding, tying arrangements between particular suppliers and traders. It was also observed that many suppliers are "tied" to selling to particular traders indefinitely as a means of discharging their debts. This credit tie, and the resultant reciprocal fish supply arrangements, were also observed between primary, intermediate, and terminal wholesalers. Similar linkages are likely to exist between wholesalers and their retail and other customers.

The highly concentrated terminal market structure makes it very easy for urban wholesalers to act collusively over price determination. The study was not able to prove this collusive behaviour empirically, but the implicit evidence is strong. The large-scale terminal wholesalers are the group of traders who are in close proximity to retailers, and this gives them reliable indicators as to the contemporary demand for fish. Armed with this knowledge, terminal wholesalers are in a position to discover the price of fish for a particular hour or day. Furthermore, because the prominent traders are small in number, each controlling a large proportion of the market and in close proximity, it is highly probable that they act collusively.

Price Instability and Marketing Margins

The study shows that prices of fish were unstable, fluctuating from time to time and dictated mainly by the nature of supply and demand. The trend of selling prices at the main markets is shown in Fig. 5. The instability of prices was pronounced, especially at the point of landing. As shown in Table 5, prices were

Table 5. Instability of prices at the main market levels for all grades of fish, Peninsular Malaysia, December 1983 – November 1984

	Instability index Dec '83–Nov '84 (%)	Increment in instability index			
		Dec–Feb	Mar–May	Jun–Aug	Sept–Nov
Exvessel	19.73	+4.77	−3.30	−0.32	−1.15
Primary wholesale	17.91	+1.09	−0.20	−2.55	+1.65
Terminal wholesale	9.00	−1.00	−2.60	+4.98	−1.38
Retail	6.82	−1.82	+2.20	−0.57	+0.19

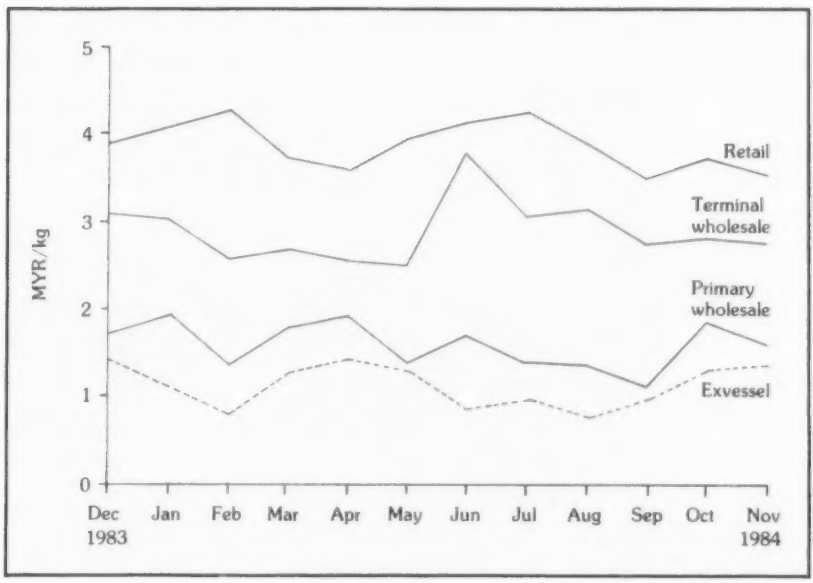

Fig. 5. Weighted average selling price at the main markets for all grades, Peninsular Malaysia from December 1983 to November 1984. (1 Malaysian ringgit [MYR] = 0.4 United States dollar [USD].)

highly unstable at the exvessel level, but the degree of instability decreased at each level thereafter with retail prices showing much less fluctuation.

Marketing margin analysis indicated that an unduly high proportion of the consumer's dollar is accounted for by profits accruing to traders, particularly by terminal wholesalers. Profits of traders accounted for an estimated 68–88% of the total margin and 38–46% of the consumer's price for all grades of fish. Product preparation and transportation each accounted for about 8% of the consumer price and producers received 40% of the final value (Tables 6 and 7).

The study team is of the opinion that the marketing margin is unduly high, in view of the relatively high proportion that is absorbed by the net profits of the various traders. Furthermore, the high marketing margins are not compensated for by efficient distribution, proper presentation/display, modern sophisticated methods of handling and processing, acceptable hygiene standards in fish markets, and flexibility of the system in adjusting itself to the ever-changing tastes and preference of consumers. The producer's low share of the retail price is aggravated by the problem of extreme instability of fish prices at the primary level as compared to the terminal level.

Conclusions and Recommendations

Field Study

(a) To alleviate the especially weak position of small-scale fishermen the following steps are recommended:

- Landing centres be provided with continuous data concerning the current and impending market situation, including weather forecasts; supply, demand, and prices in leading markets; and traffic dislocation (e.g., flooded roads);
- Short courses in fish marketing designed especially for fishermen;
- Training and advisory services to improve, measure, and compare the performance of cooperatives and associations;
- Encouragement for the formation of fishermen's marketing organizations of a size large enough to employ competent managers and other key personnel and obtain significant economies of scale; and
- Regulations to establish and maintain high and uniform standards of ice quality, ice crushing, ice-to-fish ratios, box sizes, and sorting by species and quality.

(b) To improve the marketing of fish in the metropolis and weaken the considerable power of the wholesalers there should be studies to assess the feasibility of having additional wholesale markets in the Greater Kuala Lumpur area.

(c) As there is a heavy power and ethnic concentration at all levels of the marketing of Malaysian fish and in importing, exporting, and fish transportation as well as high barriers to entry, the various trade associations should be investigated.

(d) To reduce the gross ethnic imbalance in all levels of fish marketing and

Table 6. Estimated marketing margins for grades 1, 2, and 3 fish, Peninsular Malaysia, December 1983 – November 1984.

	Grade 1				Grade 2				Grade 3			
	Margin cost		Price		Margin cost		Price		Margin cost		Price	
	MYR/kg[a]	Consumer price (%)	MYR/kg	Consumer price (%)	MYR/kg	Consumer price (%)	MYR/kg	Consumer price (%)	MYR/kg	Consumer price (%)	MYR/kg	Consumer price (%)
Producer level												
Exvessel selling price			3.46	48.53			2.63	53.13			0.87	0.37
Primary wholesale level												
Selling price			4.11	57.64			3.42	69.09			1.37	0.59
Transportation from primary wholesale markets to intermediate and terminal wholesale markets	0.12				0.12				0.12			
Sorting, cleaning, and packing	0.14				0.14				0.14			
Ice, boxes, and polythene liners	0.07				0.07				0.07			
Net profit margin	0.32				0.46				0.17			
Gross margin	0.65	9.12			0.79	15.96			0.50	21.83		
Terminal wholesale level												
Selling price			4.93	69.14			4.19	84.65			1.60	69.8
Sorting, cleaning, and packing	0.05				0.05				0.05			
Miscellaneous marketing costs	0.04				0.04				0.04			
Net profit margin	0.82				0.68				0.14			
Gross margin	0.91	12.76			0.77	15.56			0.23	10.04		
Retail level												
Selling price			7.13	100.00			4.95	100.00			2.29	100.0
Miscellaneous marketing costs	0.04				0.04				0.04			
Net profit margin	2.16				0.72				0.65			
Gross margin	2.20	30.86			0.76	15.35			0.69	30.13		
Consumer level												
Total marketing margin	3.76	52.73			2.32	46.87			1.42	62.01		
Price paid by consumers			7.13	100.0			4.95	100.0			2.29	100.0

[a] As of 1983, 1 Malaysian ringgit (MYR) = 0.4 United States dollar (USD).

Table 7. Functional analysis of marketing margins of grades 1, 2, and 3 fish, Peninsular Malaysia, December 1983 – November 1984

Service/item	Grade 1			Grade 2			Grade 3		
	Cost	% MM	% CP	Cost	% MM	% CP	Cost	% MM	% CP
Transportation	0.12	3.19	1.69	0.12	5.17	2.42	0.12	8.45	5.24
Product preparation (sorting, cleaning, and packing)	0.19	5.05	2.66	0.19	8.19	3.84	0.19	13.38	8.30
Miscellaneous marketing costs (ice, boxes, rent, telephone, water, and electricity bills)	0.15	3.99	2.10	0.15	6.47	3.03	0.15	10.56	6.55
All trader's profit	3.30	87.77	46.28	1.86	80.17	37.58	0.96	67.61	41.92
Primary wholesaler's profit	0.32	8.51	4.49	0.46	19.83	9.29	0.17	11.97	7.42
Terminal wholesaler's profit	0.82	21.81	11.50	0.68	29.31	13.74	0.14	9.86	6.11
Retailer's profit	2.16	57.45	30.29	0.72	31.03	14.55	0.65	45.77	28.38
Total	3.76	100.00	52.73	2.32	100.00	46.87	1.42	100.00	62.01

Note: % MM refers to a percentage of marketing margin and % CP refers to a percentage of consumer's price

transportation, training courses should be provided for existing and prospective traders, haulage contractors, and managers of cooperatives.

(e) The fairly extensive practice of reconsignment of fish should be closely monitored so that routine reconsignment can be eliminated where it is harmful to the interests of producers or consumers.

(f) As a step toward a compulsory national grading scheme for all 67 commercial species and sizes of fish it is proposed that there be a voluntary grading scheme for a small number of species — possibly Tenggiri, Parang, and Merah in the first instance. To be allowed to describe and display fish under the scheme, the respective boats, premises, receptacles, and vehicles would be approved and supervised.

(g) Further studies are recommended on:

- The physical conditions of wholesale markets including hygiene, refrigeration, and congestion;
- Ice quality and prices and icing practices;
- The processing sector, which is mainly cottage industry but utilizing over 170 000 t or 30% of the national catch annually; and
- Cold storage facilities.

Field Study/Earlier Research

(a) There should be a full-scale sustained effort to improve the Annual Fisheries Statistics in regard to scope, reliability, and early publication.

(b) There should be studies of:

- The alleged aversion of Malaysian consumers to frozen fish;
- The structure, conduct, and performance of the fishermen's markets;
- Public retail markets; and
- The fish procurement practices of hotels, caterers, and institutions.

(c) The marketing and market-research capability of the Fisheries Board should be strengthened considerably and supported by suitable outside specialists.

Fish Marketing Study in Sri Lanka

The UPM research team was also asked to assist in the design of a study of fish marketing in Sri Lanka. As would be expected in any late-developing country, the fisheries subsector of Sri Lanka is faced with severe production and marketing problems, such as a low level of technology, a high incidence of postharvest losses, poorly organized marketing, and slow progress in general. In Sri Lanka, there is an especially severe problem of malnutrition. As part of its aid program, the International Development Research Centre (IDRC) requested the UPM study team to comment upon and develop certain market study skeleton proposals and provide specialist advice in general.

The most urgent critical problems of Sri Lanka are twofold. First, the heavy postharvest spoilage both in terms of quantity and quality (the quality loss is of

significance as a large proportion of the edible catch — reported to be 20% — is rendered unfit for human consumption). Second, chronic malnutrition is still a conspicuous phenomenon in the Island, and this may well point to a dire need to increase productivity in the fisheries subsector both in marine fisheries and in aquaculture.

In view of the unique problems of the Sri Lanka fish subsector, the proposed scope, approach, methods, and conduct of the market research to be employed were modified considerably and tailored toward examining the prioritized areas. The focus of the survey in Sri Lanka is mainly to identify fish processing and handling problems. Concentration is recommended on certain priority species, processes, and/or population groups and some examination is needed to determine points or stages at which technological intervention will be needed to effect improvements. The UPM recommendations take account of the Island's shortage of suitable specialists in agricultural marketing in general and in fish marketing in particular.

Suggested Future Improvements

The experiences from the Malaysia fish-marketing investigation taught many useful lessons for future national and similar studies of the marketing of perishable products. Although no research could produce a perfect set of data that fully and accurately reflects the population, the weaknesses can still be minimized. Some of the lessons learned from the fish-marketing study in Malaysia as well as the suggested improvements needed are presented in the following:

(a) The need for a reliable and up-to-date data base — a comprehensive, reliable, and up-to-date data base would make market research tasks much easier. In Malaysia, many of the official annual statistics data are inconsistent, questionable, several years out-of-date, and incomplete, thereby making them unsafe for reaching concrete conclusions or even broad judgments. A complete and updated statistical base would also simplify and minimize desk research and enable investigators to identify areas for further examination. Duplication and waste would be reduced. To facilitate future research in the fisheries subsector, there is a need to improve the fundamental statistics to provide a comprehensive and sound empirical foundation. The required basic statistics include changes in the productivity and types and ages of facilities (such as boats, ice factories, cold stores, and vehicles). One of the major statistics that is useful to the sector is that needed for tracing the physical fish flow from the landing point until it reaches consumers. No less important is the need for data to make it possible to estimate the quantity and quality loss of fish handled. All these kinds of information need to be updated annually. Data on the workforce should include actual or estimated statistics on age structure and occupational category. Indices of the main input costs should be maintained.

(b) The need to identify the scope and depth of a study and the tentative priorities — a study that has vague and broad, but shallow, objectives would yield masses of data but would be unlikely to result in a thorough scrutiny of the vital issues. A study of broad scope would, however, provide useful background information but would be of little use as a basis for the critical analysis of selected and carefully identified areas. Furthermore, with a large study involving the collection of masses of data, there is the risk of losing sight of the original objective

at some stage of the research. The monitoring, management, and processing of the data would prove unduly time consuming and of course it would be wasteful.

(c) Induction of researchers in fish production and marketing practices — the practical running of fish production, marketing, and ancillary enterprises and markets cannot be comprehended merely by attending lectures and reviewing literature. To understand the fish business calls for considerable familiarization and a lot of interviews and personal observation, reinforced if possible by firsthand seagoing and fish-trade experience. Prospective researchers are advised to familiarize themselves with these areas before attempting to design and conduct area or national studies.

(d) Efficient field management — to ensure accurate, consistent, and reliable data, it is essential to have close supervision over collection and reporting, particularly by the enumerators. This is essential for data that are to be collected from time to time, as enumerators tend to get "stale" with routine interviewing, especially in hot, humid, repetitive, unexciting conditions. Spot checks are essential for testing the accuracy of data reporting by enumerators. Besides, it is more meaningful to have a small number of qualified, trained research assistants or enumerators of proven reliability on a full-time contract basis, in preference to say a large number of less-suitable unreliable personnel and on a part-time and discontinuous basis.

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